B O N N E V I L L E   P O W E R   A D M I N I S T R A T I O N

Revised Master Plan for the Hood River Production Program

Technical Report 2008	April 2008	DOE/BP-P106494

BONNEVILLE POWER ADMINISTRATION

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Revised Master Plan for the
Hood River Production Program

Submitted by

Oregon Department of Fish and Wildlife

Confederated Tribes of the Warm Springs Reservation

To

Northwest Power and Conservation Council

Bonneville Power Administration

Prepared by

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EXECUTIVE SUMMARY

The Hood River Production Program (HRPP) is a Bonneville Power Administration (BPA) funded program initiated as a mitigation measure for Columbia River hydrosystem effects on anadromous fish. The HRPP began in the early 1990s with the release of spring Chinook and winter steelhead smolts into the basin. Prior to implementation, co-managers, including the Confederated Tribes of the Warm Springs Reservation and the Oregon Department of Fish and Wildlife drafted the Hood River Production Master Plan (O'Toole and ODFW 1991a; O'Toole and ODFW 1991b) and the Pelton Ladder Master Plan (Smith and CTWSR 1991). Both documents were completed in 1991 and subsequently approved by the Council in 1992 and authorized through a BPA-led Environmental Impact Statement in 1996.

In 2003, a 10-year programmatic review was conducted for BPA-funded programs in the Hood River (Underwood et al. 2003). The primary objective of the HRPP Review (Review) was to determine if program goals were being met, and if modifications to program activities would be necessary in order to meet or revise program goals. In 2003, an agreement was signed between PacifiCorp and resource managers to remove the Powerdale Dam (RM 10) and associated adult trapping facility by 2010. The HRPP program has been dependant on the adult trap to collect broodstock for the hatchery programs; therefore, upon the dam's removal, some sort of replacement for the trap would be needed to continue the HRPP. At the same time the Hood River Subbasin Plan (Coccoli 2004) was being written and prompted the co-managers to considered future direction of the program. This included revising the numerical adult fish objectives based on the assimilated data and output from several models run on the Hood River system.

In response to the Review as well as the Subbasin Plan, and intensive monitoring and evaluation of the current program, the HRPP co-managers determined the spring Chinook program was not achieving the HRPP's defined smolt-to-adult (SAR) survival rate guidelines. The observed low SAR was due to precocity, straying, and incidence of BKD in the spring Chinook program; which ultimately led to the program's inability to achieve the subbasin's overly optimistic biological fish objectives. The summer steelhead hatchery program was not providing the fishery or population benefits anticipated and will be discontinued. The winter steelhead program was performing as planned and no changes are foreseen. This updated Master Plan addresses the several proposed changes to the existing HRPP, which are described below.

Spring Chinook

- A move towards improved HRPP spring Chinook performance following a comparative release evaluation. Specifically, co-managers are proposing a one-generation (5 year) comparative hatchery release evaluation that compares the size at release, precocial maturation, straying, disease burdens, and SARs of spring Chinook released in the Hood River Basin that are reared at one of three facilities: 1) the Carson National Fish Hatchery in the Wind River drainage (WA); 2) the Round Butte

Hatchery / Pelton Ladder in the Deschutes Basin (OR); and 3) the Parkdale Fish Facility (PFF) in the Hood River Basin. The results will provide the necessary information for co-managers to determine a long-term, biologically sound and cost effective spring Chinook salmon production strategy for the Hood River Basin that balances harvest needs with ecological considerations.

- If the results of the comparative study determine that rearing at Carson Hatchery and/or PFF is the most effective rearing strategy, spring Chinook rearing would be transferred from the Pelton Ladder and Round Butte Hatchery in the Deschutes River to the other facilities. In the Hood River, rearing would include the existing PFF and a new facility proposed to be located adjacent to a new floating weir at Moving Falls in the West Fork (RM 2.5). Infrastructure for the Moving Falls facility would be installed during weir construction at the site; however, the use of the site for full time rearing would be determined in the future. Test groups of spring Chinook will be reared at the PFF beginning in broodyear 2008 for the comparative release studies.
- Expansion of a hatchery spring Chinook program from an annual release of 125,000 to 150,000 smolts beginning in 2010.
- Fish would be acclimated and released in the West Fork at Moving Falls. Future releases in the Middle Fork will be re-evaluated.
- PFF will be retro-fitted to produce a minimum of 30,000 full term smolts by 2010. Test groups of spring Chinook will be reared at PFF beginning in BY 08 for comparative release studies.

Summer Steelhead

- The summer steelhead hatchery program will be discontinued with the last smolt release in 2008. Cessation of the program is based on several factors:
    - Because the summer steelhead stock is at risk of extirpation, recent studies suggest that current hatchery practices such as those implemented through the HRPP could potentially harm wild populations. Araki et al. (2007) found that the fitness of naturally-produced fish born of wild (W) and hatchery-reared (H) parents (W x H) is significantly lower than that of fish born of only wild parents when hatchery-reared parents are of the second generation of captivity (Araki et al. 2007). Therefore, release of hatchery-reared fish that may return as adults and spawn with wild fish could potentially harm the natural population.
    - At present, too many hatchery fish are believed to successfully spawn in the wild, violating the Hatchery Science Review Group's (HSRG) criteria of less than 5% escapement.
    - The program's ability to collect hatchery broodstock entirely from the wild run is limited due to low returns, and in most years would likely require the program to take more than 25% of the wild run in order to collect numbers sufficient to properly implement the program.
    - Summer steelhead return during periods of high turbidity in the Hood River and anglers are not very successful at exploiting this fishery. Therefore, the

need for hatchery supplementation of summer steelhead for harvest purposes is not great.
- With dam removal, the future lack of an adequate trapping site low in the basin would preclude the ability to estimate run size, determine run composition, and remove hatchery fish to comply with ESA and HSRG requirement.
- Brood collection will cease in run year 2007.
- The need to resume supplementation will be evaluated after two generations of post supplementation wild returns.

Winter Steelhead

- In consideration of genetic studies discussed above for summer steelhead, the existing program, which uses only wild stock, will continue unless the use of all wild broodstock results in taking more than 25% of the wild population. If that occurs, co-managers will re-evaluate broodstock collection and consult with NOAA Fisheries.
- Continue existing program with a production release of approximately 50,000 smolts. The current strategy for releasing 50,000 hatchery winter steelhead smolts was established to ensure a balance between returning wild and hatchery adults spawning in the basin.
- Evaluate the need to increase or decrease production in 2010.

General

- Replacement of the existing adult trap facility at Powerdale Dam with two floating weir traps, one at Moving Falls on the West Fork, and one on the Lower East Fork downstream of the Middle Fork.
- Provide flood protection at the existing Parkdale Fish Facility.

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BKD – bacterial kidney disease

BPA – Bonneville Power Administration

CI – confidence interval

CTWSR – Confederated Tribes of the Warm Springs Reservation

CWT – coded wire tags

DART – Data Access in Real Time

DPS – distinct population segment

EDT – Ecosystem Diagnosis and Treatment Model

EFID – East Fork Irrigation District

EIS – environmental impact statement

ELISA – enzyme-linked immunosorbent assay

ESA – Endangered Species Act

ESU – evolutionarily significant unit

FID – Farmers Irrigation District

fpp – fish per pound

FR – Federal Register

H – hatchery

HGMP – Hatchery Genetics Management Plan

HOR – hatchery origin return

HRPP – Hood River Production Program

HSRG – Hatchery Science Review Group

IHOT – Integrated Hatchery Operations Team

ISAB – Independent Scientific Advisory Board

ISRP – Independent Scientific Review Panel

LWD – large woody debris

M&E – monitoring and evaluation

NMFS – National Marine Fisheries Service

NOB – natural origin broodstock

NOR – natural origin return

NPCC – Northwest Power and Conservation Council

ODFW – Oregon Department of Fish and Wildlife

OSH – Oak Springs Hatchery

OWEB – Oregon Watershed Enhancement Board

PFF – Parkdale Fish Facility

PSMFC – Pacific States Marine Fisheries Commission

RBW – resistance board weir

RBH – Round Butte Hatchery

RM – river mile

RMIS – Regional Mark Information System

RRS – relative reproductive success

RU – recovery unit

SAR – smolt-to-adult ratio

TMDL – Total Maximum Daily Load

UCM – Unit Characteristic Model

W – wild

CHAPTER 1: INTRODUCTION

1.1 Purpose of the Master Plan

The Northwest Power and Conservation Council (Council; formerly Northwest Power Planning Council) requires Master Plans for new and revised programs and facilities proposed to restore salmon populations throughout the Columbia River Basin. The purpose of the Master Plan is to provide the Council and program proponents with the information necessary to determine if the proposed program should move forward into the environmental compliance and design phase. The Master Plan fulfills step one of the current 3-step planning and approval process for funding under the Council's Fish and Wildlife Program.

The Hood River Production Program (HRPP) is a Bonneville Power Administration (BPA) funded program initiated as a mitigation measure for Columbia River hydrosystem effects on anadromous fish. It is jointly implemented by the Confederated Tribes of the Warm Springs Reservation (CTWSR) and the Oregon Department of Fish and Wildlife (ODFW). The HRPP consists of supplementation, research, monitoring, evaluation, and habitat improvements. With regard to supplementation, spring Chinook, summer steelhead, and winter steelhead are released annually into the Hood River to boost adult escapement. Broodstock are currently collected at the Powerdale Dam Fish Trap and held at the Parkdale Fish Facility (PFF). Incubation and rearing occurs primarily at facilities outside the Hood River Basin on the Deschutes River.

Monitoring, research, and evaluation includes migrant fish trapping, life history data collection, creel surveys, spawning surveys, electrofishing, radio tracking, and genetic sampling. Habitat projects include riparian fencing, fish passage improvements, irrigation ditch to pipe conversion, addition of instream large woody debris and riparian plantings, water quality monitoring, habitat assessment, and watershed council support.

This plan addresses modifications to the HRPP originally developed in 1991. Proposed changes to the current HRPP include:

- An increase in the total number of spring Chinook smolts released from 125,000 to 150,000.
- Cessation of the summer steelhead program with last smolt release in 2008. The need to resume supplementation will be evaluated after two generations of post supplementation wild returns.
- Continue existing winter steelhead program with a smolt release of approximately 50,000 unless a significant change in return or harvest rates occurs, at which time co-managers will evaluate and consult with NOAA Fisheries. Evaluate the need to change production numbers in 2010.
- Comparative release study of spring Chinook with rearing at Carson National Fish Hatchery, Round Butte Hatchery and the PFF to determine the cost to benefit ratio of various strategies for rearing hatchery spring Chinook salmon for release as smolts in

the Hood River subbasin. The study will also determine the potential for in-basin rearing at the PFF and a new facility at Moving Falls on the West Fork.

- Upgrades to the existing PFF and the development of an additional Hood River facility to rear spring Chinook in-basin (if the results of the comparative release study are favorable). Fish are currently reared out of basin at the Round Butte Hatchery and Pelton Ladder; and
- The addition of two new adult trapping facilities (floating weirs) to replace facilities lost due to the removal of the Powerdale Dam. One trap will be located at Moving Falls on the West Fork, and one will be located on the Lower East Fork downstream of the Middle Fork.

A more thorough discussion regarding the need for proposed program changes is presented in Chapter 2.

1.2 Project History

1.2.1 Background to Project Development

Prior to the HRPP, there were no public artificial production facilities within the Hood River Subbasin. However, hatchery-produced fish, both steelhead and spring Chinook, were released into the system under several programs including the Dee Hatchery, which was an Oregon State Game Commission facility that stocked steelhead and trout in the basin until the late 1960s. In 1988, a five-year hatchery supplementation program was implemented to supplement the Hood River Subbasin with spring Chinook smolts (Carson stock; O'Toole and ODFW 1991a; O'Toole and ODFW 1991b). The last release of Carson stock smolts occurred in 1991. Summer steelhead have historically been supplemented using Hood River, along with a variety of other broodstock sources. However, beginning in 1974, summer steelhead smolts were planted from the South Santiam (Skamania/Foster) stock. The last release of the Skamania summer steelhead stock occurred in 2007 since managers will lose the ability to capture returning adults with the decommissioning of the Powerdale Dam. Winter steelhead have been planted into the Hood River Subbasin since 1962, utilizing Hood River and a variety of other broodstocks (O'Toole and ODFW 1991a; O'Toole and ODFW 1991b), including out-of-basin Big Creek stock.

The Council was directed to develop and adopt "a program to protect, mitigate, and enhance fish and wildlife, including related spawning grounds and habitat, on the Columbia River and its tributaries" (Section 100 in NPPC 1987). The Council subsequently developed the Columbia River Basin Fish and Wildlife Program (Program; NPPC 1987). The Council's Program set doubling runs to the Columbia River Basin "as a reasonable interim goal to guide program planning, implementation, measurement and evaluation" (Section 203(a) in NPPC 1987). As an integral part of achieving this goal, the Council Program directed BPA to fund development of a Master Plan for artificial production facilities that could be used to rear hatchery production for the Hood River subbasin (Section 703(f)(5)(A) in NPPC 1987). On completion of the Master Plan, the Council Program further directed BPA to fund the planning, design, construction, operation, maintenance, and evaluation of these facilities (Section 703(f)(5) in NPPC 1987).

BPA funded the development of two Master Plans which outlined the rationale, and general approach, for implementing a defined group of projects that would provide the basis for achieving a comprehensive watershed goal to "Protect, enhance and restore wild and natural populations of anadromous and resident fish within the Hood River Subbasin" (as cited in Coccoli 2000, Figure 1). The Hood River Production Master Plan (O'Toole and ODFW 1991a; O'Toole and ODFW 1991b) and the Pelton Ladder Master Plan (Smith and CTWSR 1991) were both completed in 1991 and subsequently approved by the Council in 1992. BPA also funded a later document which outlined how the various projects identified in the Master Plans would be structured with respect to administration and coordination, administrative organization, NEPA compliance, implementation, and monitoring and evaluation. The final document, completed in July, 1993, was titled the "Hood River/Pelton Ladder Master Agreement" (ODFW and CTWSR 1993).

Following the completion of the Hood River Production Master Plan in 1991 (O'Toole and ODFW 1991a; O'Toole and ODFW 1991b), several HRPP milestones were achieved:

- 1992: Data collection began at Powerdale Dam with the operation of existing trapping facilities at the dam.
- 1994: Modifications to the Pelton Ladder were completed, enabling hatchery spring Chinook juveniles to rear in the ladder cells for reintroduction.
- 1994-1995: First run of Hood River stock winter steelhead returned to the basin.
- 1996: HRPP EIS completed and a Record of Decision signed.
- 1997: Powerdale Adult Fish Trap facilities completed, allowing for data collection and management of the Hood River subbasin fisheries.
- 1997 First return of Deschutes stock spring Chinook to the Hood River.
- 1998: PFF completed to serve as an adult holding, spawning, and acclimation facility on the Middle Fork Hood River for summer and winter steelhead and spring Chinook.
- 1998: Additional raceways constructed at Oak Springs Hatchery for summer steelhead rearing.
- 1998: The HRPP began prohibiting Skamania summer steelhead stock from passing upstream of the Powerdale trapping facility. The ODFW-funded and operated Skamania program released summer steelhead smolts, with the last release occurring in 2007.
- 2000: Completion of the Draft Hood River Subbasin Summary (Coccoli 2000).
- 2001-2002: First run of Hood River stock summer steelhead returned to the basin.
- 2003: Completion of 10-year HRPP Review (Underwood et al. 2003).
- 2004: Completion of the Hood River Subbasin Plan (Coccoli 2004).
- 2004: PIT tagging of wild spring Chinook began per recommendations of the ISRP.
- 2005: PIT tagging of hatchery winter steelhead began.
- 2007: PIT tagging of hatchery spring Chinook begins.

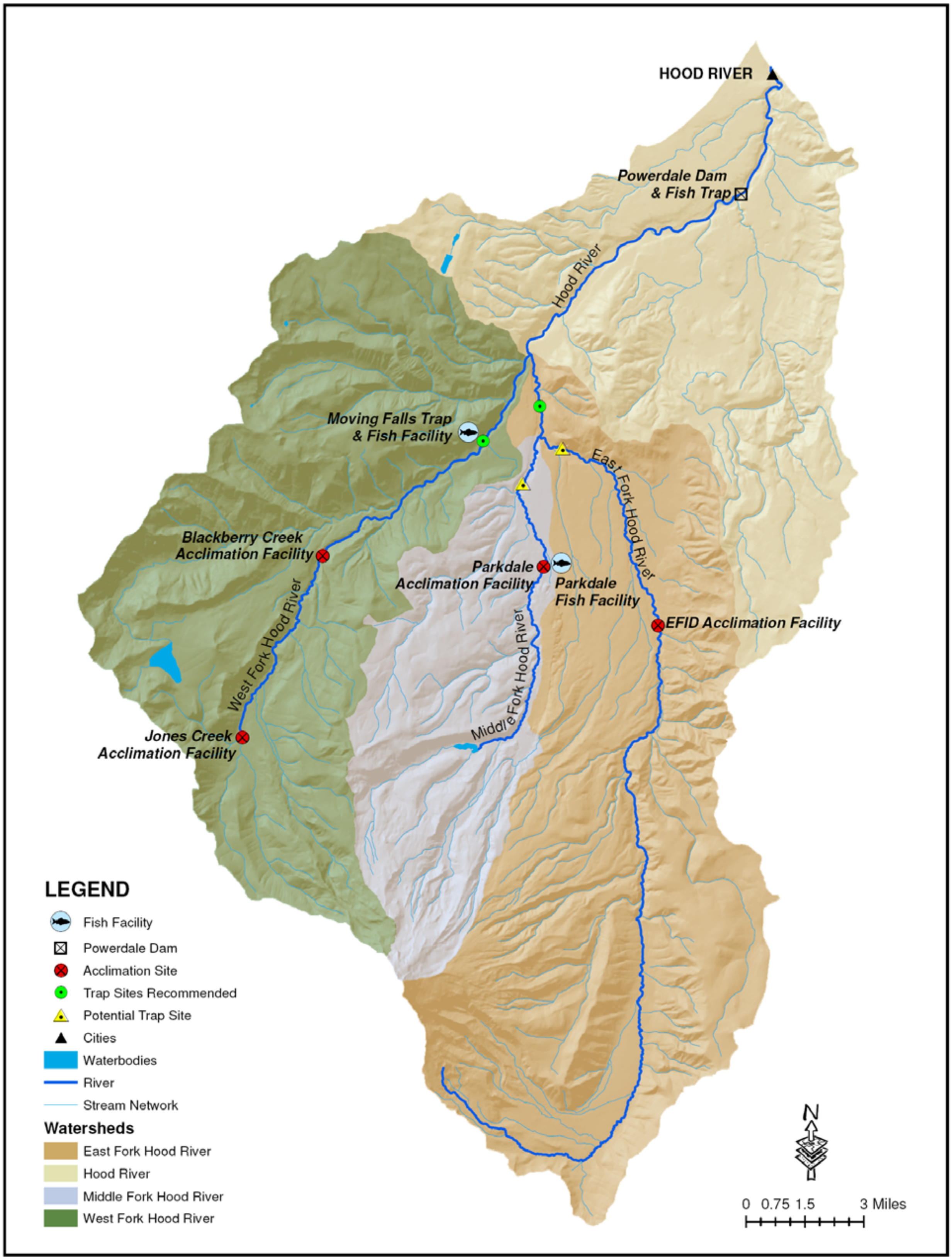

Figure 1: Hood River Subbasin, Showing Location of HRPP Current and Proposed Facilities

Projects and tasks identified in both of the Master Plans, as well as the Master Agreement, collectively fall under the umbrella of what has come to be defined as the HRPP.

BPA, within the framework of the HRPP, provided funding to design, construct, and operate the facilities needed to fully implement the hatchery summer and winter steelhead and spring Chinook salmon programs as proposed for the Hood River subbasin in the Hood River Master Plans (O'Toole and ODFW 1991a; O'Toole and ODFW 1991b; Smith and CTWSR 1991). Hatchery facilities that were funded by BPA primarily included (Figure 1): 1) an adult collection facility at Powerdale Dam; 2) an adult holding pond and spawning and incubation facilities near the city of Parkdale; 3) incubation facilities at Oak Springs Hatchery (OSH) and Round Butte Hatchery; 4) juvenile rearing facilities at OSH and Pelton ladder; and 5) acclimation ponds in the West, Middle, and East forks of the Hood River subbasin. Oak Springs Hatchery, Round Butte Hatchery, and Pelton ladder are satellite hatchery facilities located in the Deschutes River subbasin. Construction of the HRPP's hatchery facilities was completed by the fall of 1998. A description of how the HRPP has evolved into the present day program is provided in Olsen et al. (1994; 1995; 1996; 2004, and 2007), Vaivoda and McCanna (2004), Vaivoda et al. (2005), McCanna et al. (2006, 2007).

1.2.2 HRPP Goals

The original HRPP goals include: 1) increasing production of wild summer and winter steelhead trout (*Oncorhynchus mykiss*) commensurate with the subbasin's current carrying capacity, 2) re-introducing spring Chinook salmon (*Oncorhynchus tshawytscha*) into the Hood River Subbasin, and 3) providing tribal and recreational fisheries for winter and summer steelhead and spring Chinook. The HRPP's performance criteria relative to its biological fish objectives (i.e., numerical harvest and escapement objectives) are identified in the Hood River Subbasin Summary (Coccoli 2000). Specifically, the intent of the hatchery supplementation component of the HRPP was to restore subbasin fisheries within the context of a set of guidelines that were defined in the Hood River Subbasin Plan. These guidelines were established by the CTWSR and ODFW and were the basis for developing and implementing the HRPP. These guidelines are as follows:

1. The rehabilitation program will be consistent with tribal treaty rights, US-Canada Pacific Salmon Treaty and Columbia River Management Plan harvest and production agreements, the Council's Columbia River Basin Fish and Wildlife Program, and other applicable laws and regulations.
2. Re-establish naturally-sustaining spring Chinook runs in the Hood River Subbasin.
3. Rebuild naturally sustaining summer steelhead runs in the Hood River Subbasin.
4. Rebuild naturally sustaining winter steelhead runs in the Hood River Subbasin.
5. Maintain the genetic character of naturally producing populations of salmonids native to and re-established in the Hood River Subbasin.
6. Protect high quality habitat and restore degraded fish habitat.
7. Contribute to Columbia River tribal and non-tribal fisheries, ocean fisheries, and the Council's interim goal of doubling salmon runs.
8. Provide sustainable tribal and non-tribal harvest of salmon and steelhead.

9. Achieve established numerical fish objectives for adult returns to the mouth of the Hood River.

As shown above, two of the HRPP's primary goals are to re-establish spring Chinook and to help rebuild runs of winter and summer steelhead. Specific numerical objectives established to reach those goals were identified for each stock in the 1991 Master Plan. These biological objectives (i.e., numerical harvest and escapement objectives) are identified in Table 1.

Table 1: Original 1991 Master Plan Average Annual Biological Objectives to be Attained by 2016 for each HRPP Stock (NI=not identified)

Objective	Spring Chinook		Winter Steelhead		Summer Steelhead	
	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery
Adult Escapement to Mouth of Hood R.	1,700		5,000		8,000	
Adult Escapement to Natural Production	400		2,400		2,400	
Broodstock Collection	220		90		160	
Harvest (Tribal & Sport)	1,080		2,510		5,440	
Smolt production	24,000	250,000		85,000		40,000
Egg-to-Smolt Survival	NI	NI	NI	NI	NI	NI
Smolt-to-Adult Survival	0.68%	0.68%	NI	NI	NI	NI
Pre-Spawn Mortality	10%	10%	NI	NI	NI	NI
Tribal & Sport / Incidental Harvest	63%	63%	NI	NI	NI	NI
Hatchery Origin Return Natural Spawn	NA	<100%	NI	25%	NI	50%

Escapement and broodstock collection objectives associated with the 1991 Master Plan were developed prior to any data collection associated with the HRPP. For steelhead, numerical fish objectives were based on the assumption that smolt-to-adult survival rates would average approximately 4.5% for natural and hatchery produced fish (ODFW and CTWSR 1993). The original Master Plan's program called for an annual release of 150,000 hatchery summer steelhead, and 85,000 winter steelhead smolts into the basin. However, the EIS recommended an experimental phased-release approach, and the actual release numbers were much lower. For spring Chinook, numerical objectives were based on the assumption that smolt-to-adult survival rates would average approximately 0.68% for both natural and hatchery produced fish (ODFW and CTWSR 1993). The original Master Plan's proposed target smolt release goal for spring Chinook was 250,000; however, the number of Chinook smolts to be released was reduced to 125,000 in the Master Agreement.

The HRPP's proposed production release for spring Chinook smolts was further refined in the Hood River/Pelton Ladder Master Agreement (ODFW and CTWSR 1993). The spring Chinook smolt release was reduced from 250,000 to 125,000 in consideration of potential interactions with the native steelhead population present in the subbasin (CTWSR and ODFW 1993) as well as limitations of rearing infrastructure and consideration of the phased approach to rearing, which was recommended following the outcome of the HRPP Review (Underwood et al. 2003).

The Master Plan outlined that implementation of the HRPP would occur at facilities to be constructed adjacent to the Powerdale Dam. However, the Master Agreement identified water supply and construction difficulties relative to that proposal and co-managers proposed that the Powerdale facility be used only for adult trapping, counting, and sorting and that alternative facilities be used for implementation of the plan with respect to rearing. The Master Agreement re-iterated the numerical fish objectives of the HRPP – the return of 1,700 spring Chinook, 5,000 winter steelhead, and 8,000 summer steelhead to be achieved through natural production and the release of smolts produced for the HRPP. Numerical spawner escapement objectives (i.e., to meet subbasin carrying capacity) were estimated to be 400 for spring Chinook and 2,400 for both winter and summer steelhead, with half (1,200) of the contribution to steelhead spawning escapement from wild fish and half (1,200) from hatchery fish.

In 2003, a 10-year programmatic review was conducted for BPA-funded programs in the Hood River (Underwood et al. 2003). The Hood River Program Review (Review) satisfied a requirement of the Hood River Fisheries Program EIS of March 1996. The agency representatives involved in the development of that EIS recognized a need to review the status, progress, and the possible need for modification of various aspects of the program (adaptive management) after a reasonable period of program implementation had occurred. The Review evaluated the status, problems, and progress of all aspects of the program. The primary objective of the Review was to determine if the HRPP was achieving the numerical fish objectives, and if modifications in program activities would be necessary in order to meet or revise the programs performance criteria and guidelines. Following the completion of the Review, the co-managers considered the future direction of the program. This included revising the program's numerical fish objectives; which was done based on the assimilated data and output from several models run on the Hood River system. Additionally, the Review determined that new collection facilities were needed to adapt to changing conditions in the basin (i.e. removal of Powerdale Dam).

As a result of the Review, the Hood River Subbasin Plan (Coccoli 2004) presented a set of revised biological fish objectives for some aspects of the program. The numerical component of each objective was based on various assumptions about subbasin smolt and spawner escapement carrying capacities, egg-to-smolt survival rates, smolt-to-adult survival rates, pre-spawning mortality rates, and current escapements of anadromous salmonids to the mouth of the Hood River (Olsen 2007). Biological fish objectives as presented in the Subbasin Plan (Coccoli 2004) include:

Spring Chinook Salmon

- Achieve an average spawning escapement of 125 natural-origin spring Chinook returning to the Hood River by 2014, and an average spawning escapement of 200 by 2019.
- Achieve an increase in natural smolt production from 15,700 smolts to 20,000 smolts by 2019.
- Achieve and maintain a naturally-spawning spring Chinook population consisting of a stock that is adapted to the Hood River.
- Increase the smolt-to-adult survival rate of hatchery-reared spring Chinook.

- Provide an annual average harvest of 2,000 spring Chinook for tribal and nontribal fisheries by 2019.

Summer Steelhead

- Achieve and maintain an average wild/natural-origin spawning population of 600 adult summer steelhead returning to the Hood River by 2019.
- Achieve and increase in habitat carrying capacity from 13,860 smolts to 20,000 by 2019. This assumes a 3% smolt-to-adult survival rate to meet the 600 adult objective.
- Maintain the unique genetic character of wild summer steelhead in Hood River.

Winter Steelhead

- Achieve and maintain an average wild/natural-origin spawning population of 1,100 adult winter steelhead returning to the Hood River by 2019.
- Retain the genetic integrity of wild winter steelhead in the Hood River Subbasin.

1.2.3 Summary of Hatchery Practices

The BPA-funded spring Chinook program began in 1992, the winter steelhead program began in 1991, and the summer steelhead program began in 1997. A detailed description of hatchery activities is presented in Chapter 4 of the Review (Underwood et al. 2003). In summary, three hatchery facilities are currently associated with the HRPP: two in the Deschutes Basin – Round Butte/Pelton Ladder and Oak Springs, and one in the Hood River Basin – the PFF. Adults are currently collected at the Powerdale Dam and transferred to PFF for spawning (some adults return directly to PFF). Subsequent eggs are transported to the facilities in the Deschutes River Basin for incubation and rearing. Chinook eggs are taken to the Pelton/Round Butte Facility, and steelhead eggs are taken to the Oak Springs Hatchery for final rearing to the smolt stage.

Spring Chinook

The indigenous spring Chinook stock was believed to be extirpated by the early 1970s (CTWSR and ODFW 1991). The current population of Hood River spring Chinook was introduced as part of the HRPP using Chinook from the Deschutes River. Spring Chinook are incubated and reared at the Round Butte Hatchery until they are fry totaling approximately 8-12 fish per pound. Due to space constraints in the Round Butte Hatchery, fingerling spring Chinook are transferred in November to the Pelton Ladder for intermediate rearing (Underwood et al. 2003). As of BY 2007, all Round Butte Hatchery raceways are used for upper Deschutes re-introduction (C. Brun, CTWSR, pers comm.). In 1995, three rearing cells were constructed in the Pelton Ladder to rear Deschutes stock hatchery spring Chinook salmon for release into the Hood River.

Once rearing is completed at Round Butte, fish are trucked back to the Hood River subbasin in the spring. Prior to the initiation of acclimation which began in 1996, a target of 125,000 spring Chinook smolts were directly released into the Hood River. Currently, smolts are held in acclimation facilities for a minimum of six days prior to release to reduce stress and improve survival (Schreck et al.1989; Whitesel et al. 1994). Beginning in 1996, 55,000 smolts were released in the West Fork Hood River from the Blackberry Creek acclimation site (RM 8.5), and beginning in 1998, 40,000 smolts were released from the Jones Creek acclimation site (RM 14; CTWSR and ODFW 2000). Portable raceways were used to acclimate and volitionally release smolts. Approximately 30,000 smolts are acclimated for up to six weeks in a single raceway at the PFF and volitionally released from 1996 to present. Non-migrants from all facilities are trucked to the mouth of the Hood River and released. Table 2 shows the current release targets for spring Chinook smolts in the Hood River Basin, as well as release targets for summer and winter steelhead. Figure 2 and Figure 3 depict hatchery practices for all HRPP stocks.

Table 2: Current Target Anadromous Smolt Releases into the Hood River

Species	Number	Stock	Stream	Sites/Type	Release Duration
Spring Chinook	95,000	Deschutes	West Fork Hood River	2 sites, acclimation	1996-2007
Spring Chinook	30,000	Deschutes	Middle Fork Hood River	1 site, acclimation	1997- present
Summer Steelhead	30,000	Skamania[1]	Mainstem RM 4.5	1 site, direct release	1998- 2007
Summer Steelhead	40,000	Hood River	West Fork Hood River	1 site, acclimation	1998- present
Winter Steelhead	30,000	Hood River	East Fork Hood River	1 site, acclimation	1996- present
Winter Steelhead	20,000	Hood River	Middle Fork Hood River	1 site, acclimation	1999- present

[1] Released as part of a separate artificial propagation program, the ODFW Skamania stock program. The original production release guideline of 75k was reduced to 30k in 2003; last release of stock in 2007.

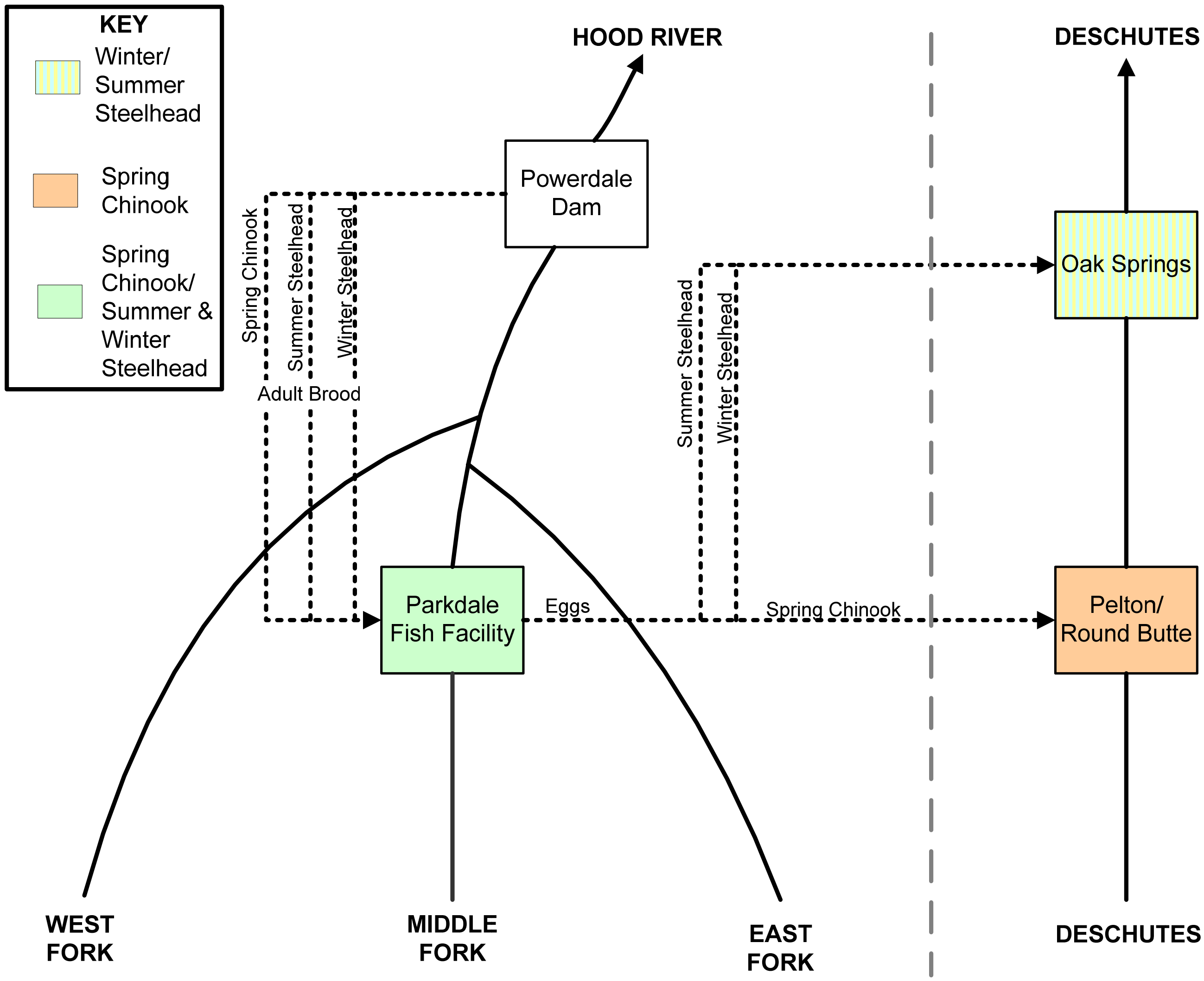

Figure 2: Current Adult Logistics for Hatchery Program

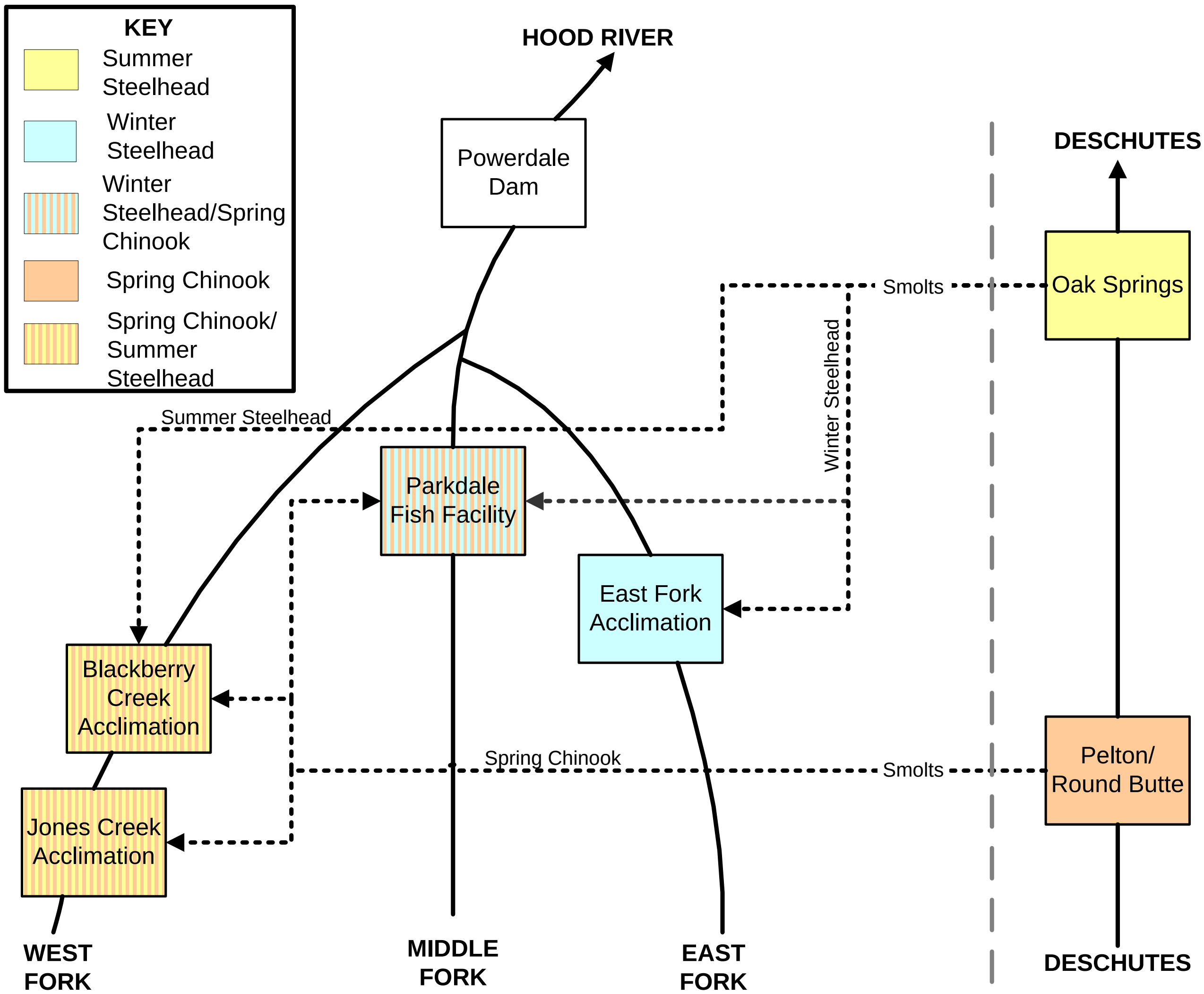

Figure 3: Current Smolt Logistics Hatchery Program

Steelhead

The HRPP summer and winter steelhead programs collect broodstock from the wild runs of steelhead escaping to the Hood River, and progeny are hatched and reared at Oak Springs Hatchery.

Summer Steelhead

HRPP Stock

The overall goal of the HRPP summer steelhead supplementation has been to increase natural production without changing the genetic makeup of the wild or naturally spawning population. The Hood River stock hatchery summer steelhead program was initiated with the collection of hatchery broodstock from the 1997-1998 run year (1998 brood). The HRPP's proposed strategy was to collect 160 adults for a production release of 150,000 smolts, with an interim strategy for collecting 40 wild adults for a production release of 40,000 smolts.

However, the program never progressed past the interim goal, due to the low number of wild fish available for broodstock.

Following rearing in the Deschutes Basin at the Oak Springs Hatchery, summer steelhead are transferred to the Blackberry acclimation site where they are acclimated and released into the West Fork in April and early May. Since 1999, approximately 30,000 summer steelhead have been acclimated and volitionally released into the West Fork. An integrated supplementation hatchery program was initiated in 1999.

Progeny of the 1998 brood first returned to the Powerdale Dam trap in the 2000-2001 run year. However, they were not passed upstream of Powerdale Dam because they were progeny of only two males and nine females and therefore were determined to be genetically unfit. Hatchery guidelines regulated the number of Hood River stock hatchery adult summer steelhead that could be passed above Powerdale Dam in order to prevent HRPP fish from swamping the wild population. The number of hatchery adults passed above Powerdale Dam in the 2002-2003 run year was regulated to randomly pass hatchery adults above Powerdale Dam in numbers not to exceed a 50:50 ratio between the wild and Hood River stock hatchery components of the summer run (Olsen 2007). This guideline remained in effect through 2005, while the HRPP's co-managers considered options for significantly increasing the ratio of Hood River stock hatchery summer steelhead adults passed above Powerdale Dam (Olsen 2007, 2003).

Various options were considered that provided a mechanism designed to more rapidly (and fully) seed existing habitat, which at the time was assumed to be underseeded. However, no action was taken on the proposal, primarily because escapements of wild summer steelhead gradually increased through the 2002-2003 run year (Olsen 2007), minimizing the need for upstream seeding. However, downward escapement trends for wild summer steelhead over the past few years have been a cause of concern and upstream seeding by hatchery fish is no longer a consideration.

The continued decline in the wild run of summer steelhead suggests a need for a biologically conservative strategy aimed at achieving the numerical fish objectives for wild summer steelhead in the subbasin. Based on data collected in the Subbasin (Underwood et al. 2003), and recent studies evaluating the overall genetic fitness of the Hood River stock of hatchery summer steelhead (Araki and Blouin 2005; Blouin and Araki 2004; Blouin and Araki 2005; Blouin and Araki 2006; Araki et al. 2007a, Araki et al. 2007b, and Araki et al. 2007c), the summer steelhead supplementation program will be discontinued, with the final release of smolts in 2008.

Skamania Stock

The ODFW-funded Skamania/Foster summer steelhead program began releasing up to 75,000 smolts into the Hood River Subbasin in the late 1980s. From 1988-1998, smolts were released into the mainstem Hood River and the West Fork. The intention of this program was to increase the number of fish available for harvest in the lower Hood River. Skamania summer steelhead were developed from Washougal and Klickitat River summer steelhead in the late 1950s at the Skamania Hatchery, Washington (Crawford 1979). This stock has been widely used in Washington, Idaho, Oregon, California, Indiana, Rhode Island, and North Carolina

(Crawford 1979, CDFG 1994). Skamania stock were introduced where indigenous summer steelhead did not naturally exist, with the intention of providing recreational angling opportunities in the Hood River.

Prior to when BPA programs were operational, Skamania stock were released into the West Fork of the Hood River. Once indigenous summer steelhead programs began releasing smolts (1998), the Skamania releases were moved to below Powerdale Dam. This action maximized angler harvest opportunity while minimizing the chance of genetic introgression between the Skamania stock and the indigenous stock. According to the Program Review (Underwood et al. 2003), DNA analysis of adult steelhead passing Powerdale Dam since 1991 revealed that Skamania summer steelhead that spawned naturally produced only 50% and 23% as many recruits per spawner from the 1995 and 1996 broods as did wild fish spawning naturally.

Winter Steelhead

The goal of the HRPP winter steelhead supplementation has been to increase natural production without changing the genetic makeup of the wild or naturally-spawning population. The first releases of smolts from the progeny of wild winter steelhead collected from the Hood River began in 1993. The HRPP's current strategy is to collect 64 adults for the production of 50,000 smolts. In accordance with wild fish protection policies, no more than 25% of the wild run is taken for broodstock. During the first 3 years of the indigenous winter steelhead program, 98% of the brood were from wild-origin fish, after which Hood River stock hatchery-origin fish were incorporated into the broodstock. From 1995-2000, wild-origin fish have composed 51% to 99% of the broodstock. From 2001 to the present, broodstock have been entirely comprised of wild fish. Adults are collected at Powerdale Dam and are held and spawned at the PFF. Prior to 1996, all hatchery-origin winter steelhead were released directly into the East Fork. Winter steelhead juveniles are currently acclimated for approximately 4 weeks at the PFF and the East Fork Irrigation District sand trap (located at RM 5.9 of the East Fork) prior to release into the Middle and East forks of the Hood River, respectively.

1.2.4 Historical Fisheries Management

The following section discusses harvest management and artificial production of spring Chinook and steelhead as part of the HRPP.

Harvest Management

An objective of the HRPP is to provide tribal and sport harvest opportunities. To this end, all HRPP hatchery Chinook and steelhead have coded-wire tags and/or fin clips to evaluate hatchery returns and protect wild fish from harvest. All non-adipose clipped fish are illegal to keep since they are presumed to be wild and protected to foster natural spawning of wild fish.

Non-Tribal Fishery

Since 1996, ODFW has monitored sport harvest of steelhead and Chinook in the Hood River Basin using creel surveys (Olsen 2001, 2007). The year-round creel survey covers the lower 4.5 river miles of the mainstem Hood River from the mouth to Powerdale Dam (RM 4.5). Sport harvest targeting summer and winter steelhead, spring and fall Chinook, and coho is restricted to below Powerdale Dam. Anglers are allowed to harvest adipose-clipped summer and winter steelhead. The harvest of adipose clipped spring Chinook salmon is opened by special regulation and generally occurs from April 1 through June 30. Fall Chinook harvest is currently closed year round. Coho harvest is allowed for fin-clipped fish only.

Trout fishing is allowed from May 24 to October 31 throughout the basin with the exception of the West Fork and its tributaries, the Clear Branch and Pinnacle Creek. The summer and winter steelhead sport fishery is augmented by collecting hatchery fish collected at the Powerdale trap and transported and released back at the mouth of the Hood River as part of a "recycle" program (Olsen 2007). The intent of this program is that recycled fish will then be subjected to another round of harvest on their way back upstream.

Coccoli (2004) states that Hood River Subbasin harvest objectives were revised in 2004 based on data collected and results of the M&E program. The Subbasin Plan combines non-tribal and tribal harvest objectives for each stock, which are defined as: 1,100 summer steelhead, 1,150 winter steelhead, and 2,000 spring Chinook salmon. Based on extrapolated creel data, harvest in the lower 4.5 river miles of the Hood River falls well short of the HRPP's numerical harvest objectives (Olsen 2007). The 1996 through 2006 average harvest of spring Chinook is 41 fish. This estimate is based on the fact that the fishery was closed in the same years as was the tribal fishery. Although catch and release is not an objective, roughly half of the catch is in the form of catch and release.

Table 3: Average Sport Harvest and Release for the Lower Hood River Mainstem (Mouth to RM 4.5) during 1996 through 2006

<table>
<tr><th rowspan="2">1996-2006</th><th colspan="2">Spring Chinook</th><th colspan="3">Summer Steelhead</th><th colspan="2">Winter Steelhead</th></tr>
<tr><th>Wild</th><th>Hatchery</th><th>Wild</th><th>Skamania</th><th>Hood R</th><th>Wild</th><th>Hatchery</th></tr>
<tr><td>Average Harvest</td><td>12</td><td>41</td><td>1</td><td>466</td><td>74</td><td>2</td><td>360</td></tr>
<tr><td>Average Release</td><td>9</td><td>23</td><td>353</td><td colspan="2">253</td><td>490</td><td>143</td></tr>
</table>

Tribal Fishery

The CTWSR holds off-reservation fishing rights at its usual and accustomed fishing sites in the Hood River pursuant to the 1855 Treaty with the Tribes of Middle Oregon (12 stat. 963). Current tribal harvest of steelhead in the subbasin is very low (Underwood et al. 2003). Tribal harvest targeting adipose fin clipped spring Chinook, has been authorized by Tribal Council resolutions during 2001, 2002, 2005, and 2007 but was prohibited in 2003, 2004, and 2006 due to forecasted low adult returns. Tribal harvest, when allowed, is monitored by the CTWSR. On average, 68 fish are harvested annually with a range of 130 to 48 adults. The majority of tribal harvest takes place from just below Punchbowl Falls (RM 0.5) on the West Fork Hood River down to the confluence with the mainstem Hood River (RM 10).

1.2.5 Habitat Improvement Actions

Since the inception of the HRPP, co-managers have worked with agencies and individuals to facilitate the implementation of actions to improve instream and riparian habitat intended to increase the carrying capacity of specific reaches relative to spring Chinook and summer and winter steelhead. Throughout the basin, habitat improvements have focused on six specific actions: instream habitat and flow restoration, riparian recovery, fish passage improvements, planning at the project and watershed level, and monitoring and evaluation of habitat activities.

Instream improvements have typically involved the addition of large woody debris (LWD) and boulders to numerous tributaries including the West Fork Hood River, Lake Branch, Clear Branch, and Robinhood and McGee creeks, among other areas (Underwood et al. 2003). The addition of instream structures is intended to increase pool habitat, cover, storage of spawning gravels, and overall habitat complexity. Future actions related to the addition of instream structures throughout the basin are proposed by co-managers (see Chapter 5). Gravel supplementation to several tributaries has also occurred, with the intent of increasing the amount of suitable spawning substrate for salmon and steelhead.

Over the past 15 years, the CTWSR, in association with landowners and other agencies, have fenced riparian areas, stabilized eroding banks, and planted riparian vegetation along numerous stream reaches in the Hood River Basin (McCanna and Wyatt 2006; Vaivoda 2003, 2004; Vaivoda and McCanna 2004, 2005). The ultimate purpose of these projects is to increase salmonid habitat and increase egg and juvenile survival through improved water quality and riparian habitat.

Fish passage improvement projects include those associated with the addition of fish screens, and culvert removals or replacement. Numerous culverts have been removed throughout the basin to eliminate barriers to upstream migration. Culvert removals have occurred at Evans Creek, Baldwin Creek, Hutson Pond, and Pinnacle Creek. Initiated in 2003, the phased Central Canal pipeline/Neal Creek inverted siphon project focuses on fish passage and East Fork flow enhancement through piping of open irrigation ditches. This project will restore 3.44 cfs of streamflow to the East Fork Hood River. Additionally, although not associated with an HRPP habitat improvement action, the decommissioning and removal of Powerdale Dam in 2010 will result in the return of a 500 cfs water right to the state of Oregon. This water will remain instream and benefit fish and wildlife by increasing stream flow in the mainstem. These streamflow restorations are anticipated to increase habitat-related parr capacity and may improve adult passage conditions, particularly during summer low flows.

1.3 Relationship to Other Plans, Programs and Projects in the Region

The new HRPP must be consistent and work in concert with other efforts to re-establish Chinook salmon and to supplement steelhead runs in the Hood River and Columbia River basins. The relationship of this Master Plan to the many on-going efforts in the region and how the plan is consistent with those programs is presented in Table 4.

Table 4: Consistency with other Programs and Plans

Program or Plan Requirement	Detail	Connection to HRPP Master Plan
1855 Treaty with the Tribes of Middle Oregon (12 stat. 963)	The CTWSR reserved "the express right of taking in the streams running through or bordering said reservation …" in the Treaty of 1855. No subsequent treaty or agreement between the CTWSR and the United States altered or affected this right.	Restoration of salmon runs resulting from fish production in the proposed facilities would assist in meeting obligations to the CTWSR made by the United States.
Oregon Forest Practices Act (1971)	Established to manage timber harvest in Oregon forests.	Where applicable, the HRPP will meet the objectives of the Forest Practices Act.
Federal Clean Water Act of 1972	In the lower Oregon Columbia Gorge tributaries, the Federal Clean Water Act is implemented in large part through the State's preparation of water quality standards, Total Maximum Daily Loads (TMDLs), and TMDL implementation by designated management agencies.	The Western Hood Subbasin TMDL for temperature was approved by EPA in January, 2002. This TMDL includes the Lower Oregon Columbia Gorge Tributaries. There are no listings on the current 303(d) list because a temperature TMDL was developed and was approved by EPA in 2002. The TMDL recommended shading in the subbasin to facilitate lower instream temperatures. Under section 303(d) of the 1972 Clean Water Act, states, territories and authorized tribes are required to develop a list of water quality limited segments. The Hood River is 303d listed for the heavy metals manganese, beryllium, copper, iron and arsenic
Endangered Species Act of 1973	Lower Columbia River steelhead were listed as threatened in March, 1998. Bull trout (*Salvelinus confluentus)* in the Hood River Subbasin are part of the Columbia River Distinct Population Segment (DPS), which was listed as federally threatened in 1998. Taking of Hood River steelhead or bull trout is regulated by the Section 7 (federal) and Section 10 (non-federal) process of the Endangered Species Act.	Activities associated with the existing HRPP have been authorized by ESA Section 10 Permits (#899). Section 7 consultations regarding effects on bull trout and steelhead from these programs have also been completed. New proposed activities may require additional consultation.

Program or Plan Requirement	Detail	Connection to HRPP Master Plan
Pacific Northwest Power Planning and Conservation Act of 1980	This Act of Congress established the Northwest Power Planning Council (Council) for the purpose of mitigating for the development and operation of hydroelectric projects within the Columbia River basin. The Council implements the Fish and Wildlife Program to protect, mitigate, and enhance fish and wildlife in the Columbia River Basin.	Proposed facilities would be funded through the Fish and Wildlife Program.
U.S. v. Oregon (1983)	Treaty fishing rights litigation addressing Columbia Basin salmon and steelhead harvest and enhancement goals.	Proposed facilities would assist in meeting obligations and agreements under the lawsuit.
Columbia River Basin Fish and Wildlife Program (NPPC 1987)	The Northwest Power Planning Council (Council) was directed to develop and adopt "a program to protect, mitigate, and enhance fish and wildlife, including related spawning grounds and habitat, on the Columbia River and its tributaries" (Section 100; NPPC 1987).	An objective of the HRPP is to increase production of salmonids (spring Chinook and summer and winter steelhead) in the Hood River Basin. The HRPP should be incorporated into the NPPC program by completing this master plan revision as part of the 3-step process.
Oregon Wild Fish Management Policy of 1987	A template developed by NMFS for anadromous salmonid hatchery programs in Washington, Oregon, and Idaho. The template will be used to assess artificial production effects on listed anadromous fish and provide a source of comprehensive information for regional production.	HRPP actions presented in this Master Plan will comply with the Management Policy.
Integrated Hatchery Operations Team, Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries (1994)	Outlines regional policies and procedures for hatchery operations in the Columbia River Basin.	HRPP will comply with recommendations of IHOT (or more conservative procedures, such as those of the HSRG).
WY-KAN-USH-MI-WA-KISH-WIT Spirit of the Salmon (1996)	The Columbia River Anadromous Fish Restoration Plan of the Nez Perce, Umatilla, Warm Springs and Yakama Tribes	Production and habitat program described in HRPP master plan are cited as key restoration actions for the Hood River basin in the this plan.

Program or Plan Requirement	Detail	Connection to HRPP Master Plan
Hood River Subbasin Plan (2004)	An evaluation of current and historic biological and physical conditions, an inventory of existing fish and wildlife programs and measures, and a management plan outlining measurable biological objectives and prioritized strategies to meet those objectives for the Hood River subbasin.	Steelhead and spring Chinook were the major focal species this plan used for assessment. Many of the findings and proposals described in this Master Plan were first articulated in the Subbasin Plan
ODFW's Native Fish Conservation Policy (implemented in 2002)	ODFW is responsible for protecting and enhancing fish and wildlife and their habitats for present and future generations.	Harvest and habitat management in the subbasin is guided by ODFW policies and federal and state legislation.
Hood River Watershed Group Action Plan (2002)	A collaboratively developed list of habitat restoration projects for the Hood River subbasin. The projects address limiting factors for salmon and steelhead natural production. The plan is the implementation plan for the Subbasin Plan.	Habitat restoration projects identified in the master plan are taken from the Action Plan.
Hood River Agricultural Water Quality Area Management Plan and Hood River County Stream Corridor Ordinance (2004)	Established to protect water quality and riparian habitat in the basin.	Where applicable, the HRPP will meet the objectives of the management plan.
Lower Oregon Columbia Gorge Tributaries Management Plan	Plan established to ensure an ecosystem with sustainable levels of fish and wildlife.	The HRPP is consistent with the plan as a goal is to supplement salmonid populations for recovery and harvest.
HSRG Initial Findings for Chinook Populations in the Lower Columbia River (2007)	The HSRG process established principles for goal setting, scientific defensibility, and adaptive management of hatchery programs.	HRPP Chinook program considered HSRG recommendations and defined program as "integrated" as well as considered the findings of the HSRG and incorporated recommendations throughout the program.
Draft Oregon Lower Columbia Recovery Plan (2007)	Developed by ODFW, with participation by NOAA Fisheries, the Oregon Governor's Natural Resources Office, and the Oregon Lower Columbia River Stakeholder Team. Draft document is a recovery plan for salmon and steelhead listed under the ESA in the Oregon portion of the Lower Columbia River Basin.	The goal of this plan is to restore Oregon's native salmon and steelhead populations and the watersheds that support them to productive and sustainable levels that will provide substantial environmental, cultural, and economic benefits. Hood River populations are included in the plan.

Program or Plan Requirement	Detail	Connection to HRPP Master Plan
Oregon Guidelines for Timing In-Water Work to Protect Fish and Wildlife Resources	Developed by ODFW in response to the creation of Oregon's Endangered Species Act in 1987.	Harvest and habitat management in the subbasin is guided by ODFW policies and federal and state legislation. Any in-water work associated with this action will be conducted within ODFW-approved work windows.

CHAPTER 2: NEED FOR THE PROJECT

The need to restore spring Chinook salmon and bolster summer and winter steelhead populations in the Hood River Basin was based on a variety of legal, historical, biological, economic, social, and cultural aspects.

2.1 Status of Hood River Fish as Related to HRPP

NOAA Fisheries currently considers the non-endemic spring Chinook produced through the reintroduction program as a segregated population unrelated to the Lower Columbia Spring Chinook evolutionarily significant unit (ESU), an ESA threatened species. The native summer and winter steelhead used by the HRPP for hatchery broodstock are included in the Lower Columbia steelhead distinct population segment (DPS), which is considered threatened under the ESA. Fish produced under the current HRPP are used towards the recovery of these populations and augment harvest opportunities. The following sections describe the status of Hood River spring Chinook and summer and winter steelhead.

2.1.1 Chinook Salmon

The Lower Columbia Chinook ESU includes all naturally-spawned populations of Chinook salmon from the mouth of the Columbia River and its tributaries upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River. This includes the Willamette River to Willamette Falls, Oregon, exclusive of spring-run Chinook salmon in the Clackamas River, as well as 17 artificial propagation programs: the Sea Resources Tule Chinook Program, Big Creek Tule Chinook Program, Astoria High School (STEP) Tule Chinook Program, Warrenton High School (STEP) Tule Chinook Program, Elochoman River Tule Chinook Program, Cowlitz Tule Chinook Program, North Fork Toutle Tule Chinook Program, Kalama Tule Chinook Program, Washougal River Tule Chinook Program, Spring Creek NFH Tule Chinook Program, Cowlitz spring Chinook Program in the Upper Cowlitz River and the Cispus River, Friends of the Cowlitz spring Chinook Program, Kalama River spring Chinook Program, Lewis River spring Chinook Program, Fish First spring Chinook Program, and the Sandy River Hatchery (ODFW stock #11) Chinook hatchery programs (NOAA 2005:FR Vol 70 No. 123). Not included in the 2005 language relative to this ESU was specific language regarding the Hood River that was included in the original 1999 listing which stated, "Not included in this ESU are spring-run Chinook salmon derived from the Round Butte Hatchery (Deschutes River, Oregon) (and their progeny) and spawning in the Hood River…" (NOAA 1999: FR Vol. 64 No. 56).

As part of the current HRPP, Deschutes hatchery-origin spring Chinook reared at the Round Butte Hatchery have been used for re-establishment of a natural Chinook run in the Hood River Basin. According to Rich Turner (NOAA Fisheries, pers. comm., 3/7/08), the conflicting language in the 1999 and 2005 ESU descriptions will be remedied in the near future, and the next generation of ESU listings will state that hatchery-derived fish from the Round Butte Hatchery, and their progeny, are not part of the ESU. Therefore, the HRPP's Deschutes-derived broodstock and subsequent progeny spawned in the Hood River are excluded from ESA section 4(d) protective regulations and are not afforded protection under the ESA.

Based on estimates of low sport harvest for the years 1977-1985 and extremely low or non-existent escapement past Powerdale Dam from 1963 through 1971 (O'Toole and ODFW 1991a; O'Toole and ODFW 1991b), it was determined that the native Hood River spring Chinook run was extinct. Because the Hood River drainage is the easternmost drainage within the Lower Columbia River ESU for Chinook salmon, the extirpated population would likely have been included in the ESU. This ESU was listed as threatened on March 24, 1999, and the threatened status was reaffirmed on June 28, 2005 (FR Vol 70 No. 123). A final designation of critical habitat was published on September 2, 2005, with an effective date of January 2, 2006 (FR Vol. 70 No. 120). The 1991 Hood River Master Plan grappled with determining the best spring Chinook stock to reintroduce into the Hood River. The Deschutes stock was deemed most appropriate due to its likely genetic similarity to the Hood River stock; the migration and age class characteristics; and operational considerations (O'Toole et al. 1991). Additional information on spring Chinook life history and factors limiting success are in Appendices C and D.

2.1.2 Steelhead

The Hood River drainage is within the Lower Columbia River ESU for steelhead, one of five ESUs for steelhead in the Columbia River Basin. This ESU was originally listed as threatened on March 19, 1998, and the threatened status was reaffirmed on January 5, 2006 (FR Vol 71 No. 3). As part of this final designation, NOAA Fisheries changed the reference term for specific steelhead populations from ESU to Distinct Population Segment (DPS). This reflects the shared jurisdiction over *O. mykiss* (which includes both anadromous steelhead and resident rainbow trout), and is consistent with NOAA Fisheries' approach for Atlantic salmon. NOAA Fisheries believes application of the joint DPS policy is logical, reasonable, and appropriate for identifying DPSs of *O. mykiss* (FR Vol. 71 No. 833). In addition to the final species designation and change to DPS, a final designation of critical habitat was published on September 2, 2005, with an effective date of January 2, 2006 (FR Vol. 70 No. 120).

The Lower Columbia DPS includes all naturally-spawned anadromous *O. mykiss* (steelhead) populations below natural and manmade impassable barriers in streams and tributaries to the Columbia River. This can be described as the area between the Cowlitz and Wind rivers in Washington (inclusive), and the Willamette and Hood rivers in Oregon (inclusive), as well as 10 artificial propagation programs: the Cowlitz Trout Hatchery (in the Cispus, Upper Cowlitz, Lower Cowlitz, and Tilton Rivers), Kalama River Wild (winter- and summer-run), Clackamas Hatchery, Sandy Hatchery, and Hood River (winter- and summer-run) steelhead hatchery programs. Excluded are *O. mykiss* populations in the upper Willamette River Basin above Willamette Falls, Oregon, and from the Little and Big White Salmon rivers, Washington.

As stated previously, the HRPP uses naturally-spawned native steelhead for hatchery broodstock; therefore, steelhead within the HRPP are included in the Lower Columbia steelhead DPS and are afforded legal protection under the ESA. However the non-indigenous Skamania (Foster) stock, which is not afforded protection under the ESA, was used for harvest augmentation in the lower Hood River. Since Powerdale Dam will be removed in 2010, the

Skamania release program was discontinued in 2007, because there will not be a reliable method of keeping this stock out of the upper mainstem and tributaries below the new weirs once the dam is removed. Additional information on the life history and factors limiting steelhead success are in Appendices C and D.

2.2 Need for Program Re-Evaluation

The need to re-evaluate the existing HRPP was based on the results of analyses conducted during the HRPP Review (Underwood et al. 2003) as well as on-going M&E studies (Olsen 2000, 2001, 2002, 2003, 2004, 2007). Results of these studies indicated that the current program is not achieving the HRPP's performance criteria relative to the program's numerically-defined biological fish objectives. An additional need for program evaluation stems from the pending 2010 decommissioning and removal of Powerdale Dam, which will render the Powerdale trap inoperable. Therefore, a new trapping facility is needed in order to continue HRPP broodstock collection and M&E activities.

The following sections describe the need for specific program changes relative to production scenarios and physical changes to collection strategies.

2.2.1 Removal of Powerdale Dam and Installation of New Trapping Facilities

Powerdale Dam, which is owned and operated by PacifiCorp, is scheduled for decommissioning during the summer of 2010. The dam is equipped with a BPA-built and funded adult trapping facility (the Powerdale Dam Adult Fish Trap). Current operation of the dam and fish trap requires that each fish is manually passed above the barrier, enabling a management decision to be made with each captured fish. This highly managed system also enables the collection of detailed information that can be used to monitor and assess the fish populations in the Hood River Subbasin. With its location low in the subbasin, this facility is also an ideal collection point for broodstock for the HRPP. In 2002, PacifiCorp requested to decommission the dam. ODFW and CTWSR requested seven years to complete genetics research, and prepare for necessary changes to the HRPP prior to removal of the dam and associated facilities.

A settlement agreement was reached with the affected agencies and stakeholders in 2003, and interim operational measures were implemented until dam removal in 2010. Removal of the dam will effectively allow for uninhibited adult upstream migration to the mid- to upper basin. As dam removal will render the BPA-funded Powerdale Fish Trap ineffective, alternative broodstock collection and escapement monitoring facilities need to be developed. The proposed development of two floating weirs upstream of the dam is intended to fulfill this need (see Chapter 4).

A potential detriment of the dam removal is limiting the ability to control the number of hatchery steelhead and spring Chinook spawning in the upper mainstem and below the proposed new weirs. However, the proposed construction of new adult collection facilities further upstream in the mainstem Hood River and West Fork tributary would allow for the collection of broodstock based on the natural migration patterns of managed stocks. Currently, because the run timing for summer and winter steelhead overlaps, broodstock collection and escapement estimates for steelhead are based on morphometric analysis along with genetic analysis to select steelhead broodstock. According to Olsen (2007), summer and winter steelhead are distinguished based on fin and maxillary mark combinations, external coloration, degree of scale tightness and erosion, state of sexual maturity relative to time of year, external parasite load, color of gill filaments, and general appearance. Although stock identification based on these qualitative characteristics has been generally validated by genetic analyses, the potential for error cannot be discounted. By trapping these fish at the mouths of each of the tributaries (those to which they naturally migrate), the separation of these stocks for broodstock collection is anticipated to be more accurate.

Winter steelhead migrate to the East and Middle forks, and based on radio telemetry studies conducted from 1994-1996, it is estimated that up to at least 5% of the wild adult winter steelhead passed above Powerdale Dam may migrate into Neal Creek (Olsen et al. 2004). Based on radio tagging studies, winter steelhead may also migrate to Green Point Creek (Olsen et al. 2004). Spring Chinook migrate to the West and Middle forks and summer steelhead migrate to the West Fork. Downstream migrant trapping suggests that spring Chinook salmon were not located in the Middle Fork until hatchery fish were released into the system (Olsen, ODFW, pers comm.). As currently proposed, the West Fork would be equipped with a floating picket weir at Moving Falls (RM 2.5), and the Lower East Fork would be equipped with a floating weir. Both of these weirs would allow for continued broodstock collection and monitoring and evaluation at these sites. The weir at the Moving Falls location would be fixed to a concrete sill, while the weir on the Lower East Fork would be attached to a cable and therefore portable. This weir could be repositioned elsewhere on the Lower East Fork or Middle Fork if future conditions deem those locations more appropriate. The Lower East Fork trap would serve to capture adults returning to both the East and Middle forks; however, if the combined stream flow of the Upper East and Middle forks proves to make trap operation too difficult, co-managers could opt to install two separate traps, one on the Upper East Fork and one on the Middle Fork.

2.2.2 Improve Hatchery Spring Chinook Performance

The spring Chinook reared at Round Butte Hatchery and released into Hood River have performed below the 1% smolt-to-adult (SAR) objective. Instead, the combined jack (age 3) and adult SAR (age 4-6) was 0.34% and the adult SAR was 0.27% for the period 1995 through 2003. The reasons for not achieving the HRPP's defined biological performance criteria for the program appear to be a combination of high mini-jack/jack rates, high tendency to stray, incidence of disease, and an overly optimistic SAR objective.

Mini-Jack and Jack Rates

Mini jacks are two year old precocious males that are released in the spring and then return in the subsequent fall to spawn. Jacks are three year old precocious males who spend one year in the ocean. Adults are considered all fish four years old or greater. Adults are the principle component of the broodstock and harvest objectives. The average spring Chinook mini-jack and jack rates of fish produced at Round Butte Hatchery and released into the Hood River are three times higher than natural rates (Underwood et al 2003). Figure 4 shows an annual average hatchery minijack rate of 22% over a 12 year period. Minijacks provide little to no benefit to the hatchery system because they are not used to fertilize eggs and little benefit to harvest because anglers do not target these small fish. Jacks do benefit the hatchery. Up to 10% of the broodstock is comprised of jacks and these fish are harvested in the fishery. The early maturation causes the young, undersized fish to return to the Hood River a year or two earlier than their adult cohorts (Figure 4). From 1994-2006, approximately one-third less hatchery adults have returned to Powerdale Dam than wild adults.

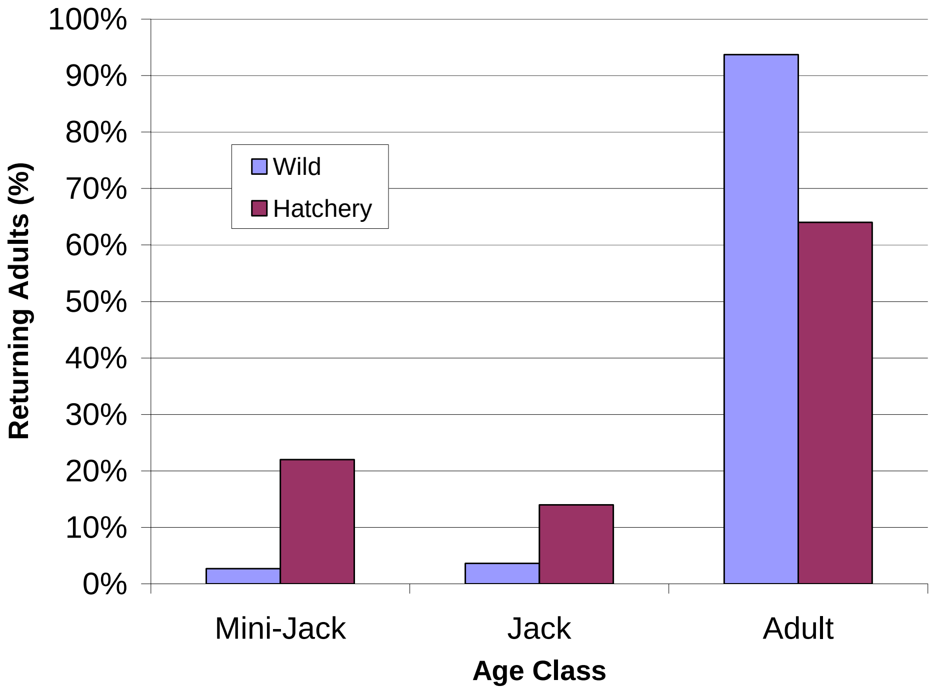

Figure 4: Percent Age Distribution of Wild and Hatchery Spring Chinook Released in the Years 1994 - 2006 in the Hood River and Returned to Powerdale Adult Fish Trap (RM 4.5)

Spring Chinook reared at Round Butte are placed into the Pelton Ladder in the fall for final grow out the winter prior to release. These fish were grown to 8-10 fpp (fish per pound) prior to release, and more recently to 12 fpp. Larsen et al. (2006) have discovered mini-jack rates of 39% to 53% for fish grown in water temperatures exceeding 50°F and fed at varying rations. The study showed how feeding less food during different periods of the rearing cycle will reduce the occurrence of mini-jacking. In response, Jack Palmer, ODFW Round Butte Hatchery manager, indicated that eggs are now incubated on cooler water to slow maturation and time to hatch. Once hatched, fish are also reared on cooler water to slow growth. Fish are now transferred to the Pelton Ladder at 20 fpp. Once in the ladder, feeding is limited to once a week from November through February. Feeding is increased to 5 times per week once the water warms and prior to March transfer to Hood River acclimation facilities (Palmer, ODFW, pers. comm., 2008). In the Hood River, the 12 fpp do not appear to mini-jack as frequently at 8-10 fpp. Early return numbers suggest roughly 10 to 15% of the 2004 and 2006 brood years will be mini-jacks.

In contrast, Carson National Fish Hatchery on the Wind River rear spring Chinook to 18 fpp or smaller in 44 to 46°F water. The result of this environment is an undetectable number of mini-jacks and 1% jack rate (USFWS 2007). Whether the cooler water, limited food, or stock differences at Carson National Fish Hatchery is the cause for the lower mini-jack rate is unknown. However, what is known is this hatchery is effective at controlling mini- and jack rates. As a result, this Master Plan proposes rearing sufficient number of Hood River Spring Chinook at Carson National Fish Hatchery to test their performance against those reared at Round Butte Hatchery and at the PFF.

Another benefit of rearing fish in the Hood River Subbasin (at the PFF or a new facility at Moving Falls on the West Fork) is that hatchery fish would be reared in water that more closely matches the natural temperature profile. This should result in sizes at release that are more similar to that of their wild counterparts, which may reduce the potential competitive advantage of larger hatchery fish.

Straying

Straying reduces the number of adults available for Hood River harvest, hatchery broodstock, and escapement. According to the Review (Underwood et al. 2003), high rates of straying prior to 2001 resulted in a lower smolt-to-adult return for the Hood River than for the Deschutes River. However, recent stray rates of Hood River hatchery spring Chinook have averaged 3.2% from 2001-2006 (Chris Brun, CTWSR, pers. comm., 11/1/2007). The perceived straying may have been an artifact of fish moving among rearing cells in the Pelton Ladder. As a result, fish with a Hood River CWT may have been released into the Deschutes River.

The proposed transfer of rearing in the Deschutes River Basin to in-basin facilities, including an improved PFF and a new facility at Moving Falls on the West Fork (see Chapter 3 for details), may result in improved homing and lower rates of straying. Fish reared in Hood River water should be more likely to return to their natal waters as adults. It should be noted that Deschutes River stock are still used for broodstock when required to supplement wild broodstock numbers (see Chapter 3 for mating scenarios, which are consistent with HSRG rules). As presented in the original Master Plan (O'Toole and ODFWa), the Deschutes stock is preferred by co-managers as it is a more locally adapted stock with a relatively high survival rate. According to Barns (1976) and Reisenbichler (1981), locally adapted fish, when used to establish and maintain hatchery stocks, are likely to be better for supplementation than are fish from other populations. This change is consistent with ODFW's Natural Production/Wild Fish Management Policy (1990). Deschutes stock has been approved for use in the Hood River by ODFW pathologists, provided the proposed production fish are checked for disease prior to release.

Disease

Finally, rearing in the Hood River Basin may reduce the hatchery incidence of bacterial kidney disease (BKD) since the spring water source for the PFF is pathogen free. Disease issues have limited the success of the Round Butte/Pelton Ladder spring Chinook rearing program in some years. BKD was a chronic problem at Round Butte Hatchery and Pelton Ladder as high levels of BKD were believed to have caused notable pre-smolt loss in the Pelton Ladder during the

1995-96 and 1996-97 rearing periods (Underwood et al. 2003). However, the Round Butte Hatchery has initiated an aggressive culling program for BKD-positive adult females, which has reduced its occurrence (Banner, ODFW, pers comm.). Adults are also now injected with erythromycin prior to spawning to minimize BKD transference. Elliott et al. (1995) determined that BKD was related to seawater survival, and the greater the infective agent load, the lower the survival. Past cleaning practices at the Pelton Ladder violated state settleable solids criteria; however, a pipe was recently added that facilitates waste removal via a weekly cleaning protocol (Palmer 2008). However, ladder cells are large, which limits the effective removal of mortalities, and complicates monitoring for disease and growth. BKD outbreaks continue to occur in the Pelton Ladder as evidenced by the 2008 presmolt outbreak, and another pathogen, the parasite *Ceratomyxa shasta* is also an issue. *C. shasta* is present in the Deschutes basin and not believed to be present in the Hood River or at Carson Hatchery (C. Brun, CTWSR, pers. comm.). As a result, transferring Pelton Ladder reared Chinook into the Hood River may be introducing *C. shasta* into that basin.

Overly Optimistic Programmatic SARs

The original spring Chinook release objective for the HRPP based on the 1991 Master Plan was 250,000 smolts (O'Toole and ODFWa). Due to uncertainties regarding carrying capacity in the basin, the production number was reduced to 125,000 following the development of the subsequent Master Agreement (ODFW and CTWSR 1993), and considered a test phase prior to investing in the infrastructure required to rear and release 250,000.

The proposed expansion of the spring Chinook program from 125,000 to 150,000 smolts is specifically intended to boost adult returns and spawning escapement and to subsequently improve tribal and sport harvest. The primary rationale for increasing production releases of spring Chinook smolts is that previous planning efforts for the HRPP used what is likely a highly overestimated SAR of 0.68% (ODFW and CTWST 1993). Evidence from other facilities in Oregon and Washington (USFWS Columbia Basin Hatchery Review Team 2007) suggests that the average SAR for spring Chinook programs is closer to 0.3% (USFWS 2007). Based on this, an increase in the number of smolts released into the basin is anticipated to facilitate increased adult returns. Additionally, the removal of Powerdale Dam and associated management will allow for more fish to move into the mid- to upper basin as more habitat is available to all individuals, regardless of origin. The proposed floating weir barrier and trap at Moving Falls on the West Fork is intended to allow for management of spring Chinook and summer steelhead moving upstream in this area. A portion of the fish collected at this facility would be used for broodstock and a portion would be passed upstream to seed habitat, while the remaining surplus would be used as a subsistence fishery food source.

Although the HRPP Review suggested a decrease in predicted wild production based on carrying capacity estimates and in-basin rearing potential, these estimates were focused on juvenile rearing and spawning habitat upstream of Moving Falls. Through the installation of a weir at the Moving Falls location, Chinook that return to the weir would face one of three fates: collected for broodstock, passed upstream to seed habitat, or taken to support the tribal subsistence fishery. As currently proposed, a minimum of 205 naturally-produced spring

Chinook adults and no greater than 5% of the natural spawners would be of hatchery origin (see Chapter 3 for further details).

2.2.3 Steelhead Programs Alterations Based on Genetic Findings

Winter Steelhead

Current hatchery programs are not likely compromising the genetic fitness of first generation wild steelhead populations in the Hood River, as genetic findings from Blouin and Araki (2004) determined absolute fitness between wild and Hood River hatchery winter steelhead was not statistically different for run years 1995, 1996, and 1997. However, recent studies have shown that the use of second generation captively-reared broodstock may result in reduced reproductive success and an overall reduction in population fitness (Araki et al. 2007). This reduced fitness is particularly concerning when considering the impact to naturally-spawning populations when hatchery-reared fish breed with wild stocks.

In consideration of the genetic findings of Araki relative to the use of F2 hatchery-reared fish for broodstock, the winter steelhead program will continue to use wild broodstock only. This collection strategy will be revisited if the number of wild fish available for broodstock versus those necessary for program implementation becomes low enough to warrant reevaluation in consideration of population viability. If it is determined that the number of wild fish necessary for broodstock exceeds 25% of the wild population, hatchery-reared fish may be used and co-managers will consult with NOAA Fisheries regarding future actions. The broodstock collection protocol for the HRPP states that no more than 25% of the wild run can be taken for eggs (Coccoli 2004).

Summer Steelhead

The proposed cessation of the summer steelhead program considers the findings of several recent studies, particularly Araki et al. (2007), that suggest that use of second generation captive-reared fish for broodstock is detrimental to reproductive fitness. Because the summer steelhead stock is at risk of extirpation, the availability of wild broodstock is limited for hatchery use and the continuation of current hatchery practices could potentially harm the wild populations. Araki et al. (2007) found that the fitness of naturally-produced fish born of wild (W) and hatchery-reared (H) parents (W x H) is significantly lower than that of fish born of only wild parents when hatchery-reared parents are second generation captive-reared (Araki et al. 2007). Therefore, release of hatchery-reared fish that may return as adults and spawn with wild fish could potentially harm the natural population.

Other reasons for discontinuing the summer steelhead program are inherent in adaptive management through consideration of the current status of wild fish. At this time, it is estimated that too many hatchery-reared fish would escape and successfully spawn in the wild. This limits the potential to collect fish from the entire run, and is in violation of current HSRG straying criteria (less than 5%). With the proposed weir site at Moving Falls, escapement would also likely exceed the 5% limit. Additionally, the lack of sufficient wild returns makes it difficult to use wild broodstock without taking more than 25% of the returning population. The final release of Hood River summer steelhead occurred in the spring of 2008, as progeny returning from later releases would not be subjected to capture at Powerdale trap. The future decision regarding whether to reinitiate the summer steelhead program will occur under consultation with NOAA Fisheries.

The final release of Skamania stock summer steelhead occurred in 2007. Elimination of this stock should also reduce risks to the wild summer steelhead population through elimination of competition between a wild population considered at "very high risk" of extinction (ODFW 2007) and hatchery-reared fish.

2.3 Sport Harvest Need

The Hood River fishery provides important harvest opportunities for recreational anglers. The spring Chinook harvest opportunity is currently low and adjustments recommended herein would provide an important sport fishery. BPA and ODFW have invested in rearing facilities and habitat renewal projects, and provided operational funding and technical support in pursuit of meeting the Hood River harvest and population objectives. These objectives have not been met as indicated in Table 5, and corrective actions are necessary.

Table 5: Estimates of Summer Steelhead, Winter Steelhead, and Spring Chinook Harvest in Non-Tribal Fisheries Located from RM 0 to RM 4.5 in the Mainstem Hood River, by Run Year (from Olsen 2007)

	Spring Chinook		Summer Steelhead			Winter Steelhead	
Year	Wild	Hatchery	Wild	Skamania	Hood R	Wild	Hatchery
1996	52	5	0	31	--	0	314
1997	40	15	4	749	--	0	319
1998	16	3	0	343	--	5	231
1999	0	0	0	355	--	0	172
2000	8	20	0	224	--	0	217
2001	0	54	0	438	1	0	351
2002	9	287	4	771	9	5	841
2003	4	13	0	814	19	5	411
2004	3	0	0	591	70	0	475
2005	0	54	0	650	145	0	182
2006	0	0	0	165	200	2	450
Average	**12**	**41**	**1**	**466**	**74**	**2**	**360**
Past Objective	**0**	**2,000**	**0**		**1,100**	**0**	**1,150**

2.3.1 Summer Steelhead

Hood River summer steelhead are subject to harvest in the Columbia and Hood River fisheries and sport harvest in the mainstem Columbia is limited to 2% of the total run. In the Hood River, sport fisheries occur from below Powerdale Dam to the mouth for hatchery summer steelhead. For the period from 1996-2006, sport anglers had an average yearly exploitation rate of 25 percent for hatchery origin winter steelhead in the Hood River (Olsen 2006). Wild fish must be released.

The exploitation rate on subbasin hatchery stocks ranged from 17-34% on non-recycled adults for the 1996-1997 through 2005-2006 run years. In 2006, peak harvest of subbasin hatchery adults occurred from January to mid-June (Olsen 2007). Run year specific estimates of harvest ranged from 52-370 recycled adult hatchery summer steelhead and the exploitation rate on recycled hatchery summer steelhead ranged from 5-96% for the 1996-1997 through 2005-2006 run years. The discrepancy between the number of recycled adults recaptured at the Powerdale Dam trap, and the number harvested in the sport fishery suggests that a large percentage of recycled adults may leave the subbasin (Olsen 2007) or die after release.

2.3.2 Winter Steelhead

Hood River winter steelhead are subject to incidental harvest in spring Chinook fisheries (allowable harvest in Chinook commercial fisheries is 2%), as well as incidental harvest in Hood River sport fisheries. Little or no winter steelhead harvest occurs in ocean fisheries (ODFW 2007). In 2006, peak Hood River hatchery winter steelhead harvest occurred from early January to late April. Exploitation rates ranged from 23% to 44% on non-recycled adults, and the exploitation rate on recycled hatchery winter steelhead ranged from 1% to 14% for the 1996-1997 through 2005-2006 run years (Olsen 2007).

2.3.3 Spring Chinook

Coded-wire tag recoveries indicate that ocean harvest of Hood River spring Chinook is low, with a limited number of tags recovered in ocean fisheries. Harvest in Hood River is variable and allowable harvest is based upon projected run size. For the 10-year period from 1996-2006, a sport harvest opportunity was allowed in 5 of 10 years (ODFW 2007). During these fisheries, catch was highly variable, with the highest sport angler exploitation rate on hatchery origin fish being nearly 30 percent in 2002 (Olsen 2006). No in-river harvest of wild origin fish was allowed for sport anglers.

Creel surveys conducted in 2006 for sport harvest on the mainstem Hood River from the mouth to Powerdale Dam estimated 0 kept unmarked jack and adult spring Chinook salmon, 14 caught and released unmarked jack and adult spring Chinook salmon, 0 kept subbasin hatchery jack and adult spring Chinook salmon, and 52 caught and released subbasin hatchery jack and adult spring Chinook salmon. Creel surveys were not conducted above Powerdale Dam due to the fact that non-tribal harvest of salmon and steelhead was prohibited above Powerdale Dam. The non-tribal fishery above Powerdale Dam was closed to the harvest of salmon and steelhead on April 1, 1998, and the closure remained in effect through the 2006 calendar year. Brun (pers. comm. 2008) estimated that an average annual of 12.3% of HRPP spring Chinook have been harvested in tribal and non-tribal fisheries from 1998-2006 when fisheries have been permitted (Table 6).

Table 6: Estimated Mean Percentage of Hood River Spring Chinook Harvested in Various Fisheries from 1998-2006

Harvest	Mean
Columbia R. Gillnet	4.23%
Columbia R. Sport	4.49%
Freshwater Sport	3.53%
Freshwater Harvest	11.64%
Other Harvest	0.63%

2.3.4 Other Species

According to ODFW (2007) fall Chinook returning to the Upper Gorge tributaries and Hood River are subject to ocean and in-river fisheries. Total harvest rate on these populations averaged 66% (1999-2002), with approximately half of the catch being from net fisheries (ODFW 2007). However, very little harvest occurs on either natural fall Chinook or coho in the lower Hood River, so increased harvest on HRPP fish does not adversely affect these species (Underwood et al. 2003). Little harvest occurred because in many years the fishery was closed on July 31 to minimize the fisheries impact on fall Chinook salmon in the Hood River subbasin.

Coho are harvested, but only clipped fish can be kept. However, bull trout is a highly catchable species, and incidental hooking mortality has likely occurred in the Hood River. Fishing is currently closed for fall Chinook due to their listing status in the Hood River.

2.4 CTWSR Harvest Needs and Spring Chinook Harvest Objectives

The Hood River is a Usual and Accustomed fish site for the Confederated Tribes of the Warm Springs Reservation. As a result, it is the trust responsibility of the federal government to rebuild fishing opportunity. Tribal harvest objectives for Hood River spring Chinook salmon are to restore consistent subsistence and ceremonial harvest opportunities for CTWSR members within their ceded lands throughout variable annual adult returns. Currently, the Deschutes River provides the only reliable in river harvest opportunity for the tribes within their ceded areas. The tribes harvested fish within the Hood River Basin for subsistence purposes prior to their relocation to reservations. While exact numbers of Chinook salmon historically harvested are unknown, it was likely much greater than what is currently available.

Several tribal families reside in the Hood River Valley and Columbia Gorge and are welcoming the return of the salmon. Many of these families have lived within the area for generations. While salmon remains an essential component of tribal culture, the ability of recent generations of tribal members to harvest salmon in the Hood River has been severely restricted through the loss of harvestable salmon runs during most of the last thirty years. The lack of harvest opportunities within the basin has forced fishers to harvest salmon at other locations. This has resulted in a loss of local fishery knowledge and access to traditional Hood River fishing sites.

Re-establishing tribal harvest in the Hood River, one goal of the HRPP, has been hindered by inconsistent annual harvest opportunities. Treaty harvest of summer steelhead is believed to be between 3.5-8.2 percent in zone 6 treaty fisheries (U.S. vs. Oregon, Consultation Number: F/NWR/2005/0388). The tribal fishery in the Hood River is centered around harvest at Punchbowl Falls. Harvest has only been allowed in four years during implementation of the HRPP. The primary rationale for increasing the production release of smolts, in addition to increased smolt survival expected from the decommissioning of Powerdale Dam and other habitat restoration efforts, is to provide a consistent annual fishery for tribal members. Tribal effort will increase as word spreads of the harvest opportunities in the Hood River. Salmon not harvested in the tribal and sport fisheries and in surplus of broodstock / supplementation needs will be fully utilized by the tribes. Those fish will be delivered to the Warm Springs Reservation and distributed to tribal members who are elderly or unable to fish themselves. Currently, all surplus fish from the Deschutes fishery are distributed to the tribes. However, fish available for distribution is insufficient for tribal needs in most years. In addition to in-river harvest of program fish, the HRPP will contribute to mainstem Columbia ceremonial and commercial fisheries.

Tribal harvest of fin clipped spring Chinook has occurred in 2001, 2002, 2005, and 2007 but was prohibited in 2003, 2004, and 2006 due to forecasted low adult returns (Table 7).

Table 7: Estimated Number of Spring Chinook Harvested in Tribal Fishery in the Hood River Basin

Year	Number of Spring Chinook
2001	130
2002	112
2003	0
2004	0
2005	48
2006	0
2007	51

2.5 Proposed Biological Objectives

In response to population and harvest objectives not being met for spring Chinook and summer and winter steelhead, the following presents the revised proposed biological objectives. Since the development of the original Master Plan and subsequent Master Agreement, co-managers (ODFW and CTWSR) have developed a revised set of escapement and harvest objectives for spring Chinook and winter and summer steelhead. These numbers are based on:

- The Hood River Program Review (Underwood et al. 2003) and the Unit Characteristic Model (UCM),
- The Hood River Subbasin Plan (Coccoli 2004) and the Ecosystem Diagnosis and Treatment Model (EDT),
- Data collected from the HRPP (1992-present),

- HSRG Production Guidelines, and
- Adjusted expectations.

Table 8 compares the numerical objectives for spring Chinook, summer steelhead and winter steelhead to the HRPP's biological performance criteria presented in the 1991 Master Plan for: 1) average observed HRPP data, and 2) the proposed objectives derived from a summary of escapement, harvest, broodstock, and survival. The number of smolts required to support production is based on escapement objectives, survival, and harvest rates. Data collected through the implementation of the HRPP was used to develop survival and harvest rates.

Table 8: Numerical Fish Objectives and biological performance criteria for the Proposed Program, Showing Comparison to 1991 Objectives and Observed Averages for Each HRPP Stock

	1991 Objective by 2016		10 Year Average		Proposed Objective by 2018	
Spring Chinook	**Wild**	**Hatchery**	**Wild**	**Hatchery**	**Wild**	**Hatchery**
Adult Escape to Mouth of Hood R.	1,700		99	399	300	600
Adult Escape to Natural Production	400		98[1]	148[1]	205	8
Broodstock Collection	220		1	108	20	180
Harvest (Tribal & Sport)	1,080		U	83	30	318
Pre-spawning Mortality	NA		U	60	45	90
Smolt production	24,000	250,000	U	120,380	15,000	150,000
Egg-to-Smolt Survival	U	U	U	U	4.4%	78%
Smolt-to-Adult Survival	0.68%	0.68%	U	0.24%	2.0%	0.40%
Pre-Spawn Mortality	10%	10%	15%[2]	15%[2]	15%	15%
Tribal & Sport / Incidental Harvest	63%	63%	1%[1]	21%[1]	10%	53%
HOR Natural Spawn (<5%)	NA	NA	NA	151[1]%	NA	4%
HSRG Rules (>0.70)	NA	NA	NA	0.02[1]	NA	0.73
Summer Steelhead	**Wild**	**Hatchery**	**Wild**	**Hatchery**	**Wild**	**Hatchery**
Adult Escape to Mouth of Hood R.[3]	8,000		300	852	510	NA
Adult Escape to Natural Production	2,400		210	175	408	NA
Broodstock Collection	160		35	3	0	NA
In-Basin Harvest (Tribal & Sport)	5,440		1	110	51	NA
Pre-Spawning Mortality	NA	NA	27[1]	22[1]	51	NA
Smolt Production		40,000	3,921	38,585[4]	7,500	NA
Egg-to-Smolt Survival	NA	NA	0.58%[1]	71.0%	1.0%	NA
Smolt-to-Adult Survival	NA	NA	7.5%	2.1%[5]	5%	NA
Pre-Spawn Mortality	NA	NA	10%[2]	10%[2]	10%	NA
Tribal & Sport / Incidental Harvest	NA	NA	0%[1]	10%[1]	10%	NA
HOR Natural Spawn (5%)	NA	NA	NA	5%[1]	NA	NA
HSRG Ratio (>0.7)	NA	NA	NA	0.67[1]	NA	NA

	1991 Objective by 2016		10 Year Average		Proposed Objective by 2018	
Winter Steelhead	**Wild**	**Hatchery**	**Wild**	**Hatchery**	**Wild**	**Hatchery**
Adult Escape to Mouth of Hood R.	5,000		662	1,003	656	1,000
Adult Escape to Natural Production	2,400		515	370	465	24
Broodstock Collection	90		68	24	60	0
In-Basin Harvest (Tribal & Sport)	2,510		2	365	66	876
Pre-Spawning Mortality	NA		60[1]	63[1]	66	100
Smolt Production		85,000	8,718	57,286	9,370	50,000
Egg-to-Smolt Survival	NA	NA	0.9%	66.4%	1.0%	75%
Smolt-to-Adult Survival	NA	NA	8.1%	1.1%[6]	7.0%	2.0%
Pre-Spawn Mortality	NA	NA	10%[2]	10%[2]	10%	10%
Tribal & Sport / Incidental Harvest	NA	NA	0%[1]	58%[1]	10%	88%
HOR Natural Spawn (<5%)	NA	NA	NA	75%[1]	NA	5%
HSRG Ratio (>0.7)	NA	NA	NA	0.64[1]	NA	0.95

[1]Computed value; [2] Assumed value; [3]Estimate assumed 10% catch and release mortality; [4]Average for Hood stock releases (1992- 2005); [5] Based on 1998-2002 five year average; [6] Based on 1993-2002 ten year average
U= unknown; NA = Not available

For spring Chinook, revised biological objectives have resulted from increased smolt release targets, which have been based on revised smolt-to-adult survival rates (SARs). The HRPP had assumed an optimistic SAR objective of 1%, which, as shown in Table 8, has not been achieved on average over the past 10 years. To develop a more realistic SAR, co-managers considered average SARs observed for other hatchery spring Chinook programs at several national hatcheries including Carson and Little White Salmon. From 1996 through 2000, the estimated SAR ranged from 0.09 to 0.66, and averaged 0.31% (USFWS 2007). This average survival estimate was used as a starting point for the HRPP spring Chinook SAR guidance and increased slightly to 0.4% to reflect assumptions that shifting production to in-basin rearing may increase smolt quality and survival.

Using this revised SAR, co-managers decided to increase the smolt release guideline to 150,000 smolts in order to increase adult returns, and to subsequently ensure sufficient surplus fish for a robust tribal and sport fishery and, if necessary, supplementation of the wild population in the upper headwaters if the HRPP's biological guideline of a 0.4% SAR is not consistently achieved. Instrumental to the production release guideline is the inclusion of a 100%-efficient spring Chinook barrier in the West Fork at Moving Falls. The barrier will limit the number of hatchery spring Chinook migrating upstream to protect wild fish from an over-seeding of hatchery fish in the upstream habitat. This new production release guideline is slightly greater than the current production levels of 125,000 spring Chinook smolts, but lower than the 1991 guideline of 250,000 smolts. The 150,000 strikes the balance between the HRPP's harvest and wild production objectives and ensures sufficient returns for complete in-basin broodstock collection, when considering anticipated survival improvements (through reduced jacking and straying) of rearing fish within cooler water facilities such as the PFF in the Hood River Basin, rather than the Deschutes River Basin.

Summer Steelhead

The HRPP summer steelhead program will be discontinued with final smolt releases in 2008 allowing the wild summer steelhead population to rebuild without supplementation. Managers do not believe they can control the number of hatchery-origin fish that would likely spawn in among wild fish with the loss of the Powerdale fish trap. Angler success is limited during the peak of the hatchery-origin summer steelhead adult return, which would result in greater in-basin escapement and spawning. The HSRG rule of allowing no more than 5% of the hatchery fish to spawn in the wild would be violated. This decision was also made because frequently the number of wild returning summer steelhead is not large enough to support a hatchery program and achieve the HSRG rule of collecting no more than 25% of the wild returning adults for hatchery production. Araki et al. (2007) suggests that the use of second generation captive-reared fish for broodstock is detrimental to reproductive fitness so the use of returning hatchery adults progeny is not a sound practice towards rebuilding a population.

Instead of relying on hatchery production to rebuild the population, the managers will regulate sport fisheries to improve escapement to the spawning grounds and continue to search for opportunities to improve habitat conditions.

Winter Steelhead

No changes in the current production scenario are proposed for winter steelhead, although modifications to the smolt release objective may occur if the number of hatchery winter steelhead exceeds the in-basin spawning objective of 5% of the wild return. The current acclimation practices employed under the HRPP appear to be successful, and as such, no changes are proposed to the hatchery system for winter steelhead.

CHAPTER 3: PROPOSED PRODUCTION ALTERNATIVES

3.1 Program Objectives

Based on the HRPP Review, observed SAR estimates, and recent understandings regarding the viable hatchery programs, new biological objectives are proposed for spring Chinook, and winter and summer steelhead as part of the updated HRPP (Table 9).

Table 9: New Biological Objectives for the HRPP

Factor	Spring Chinook		Winter Steelhead		Summer Steelhead	
	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery
Adult Escape to Mouth of Hood R.	300	600	656	1,000	510	0
Adult Escape to Natural Production	205	8	465	24	408	0
Broodstock Collection	20	180	64	0	0	0
In-Basin Harvest (Tribal & Sport)	30	318	66	876	51	0
Pre-Spawning Mortality	45	90	66	100	51	0
Smolt Production	15,000	150,000	9,370	50,000	7,500	0
Egg-to-Smolt Survival	4%	78%	1%	75%	1%	0%
Smolt-to-Adult Survival	2.0%	0.4%	7.0%	2.0%	5.0%	0.0%
Pre-Spawn Mortality	15%	15%	10%	10%	10%	0%
Tribal & Sport / Incidental Harvest	10%	53%	10%	88%	10%	0%

The following sections focus on the spring Chinook production program by providing a review of the rationale behind the program objectives, alternatives explored to achieve the numerical fish objectives and a detailed description of the preferred alternative. Winter and summer steelhead are not considered further in the chapter since summer steelhead will no longer be supplemented with hatchery stock, and no changes to production scenarios for winter steelhead (besides program guidelines for collecting all wild broodstock) are proposed.

3.1.1 Objective Development

Guidelines established for the spring Chinook program are designed to achieve an integrated hatchery program with adequate surplus to sustain sport and tribal harvest objectives (Table 8 and Table 9). This plan intends to balance wild production objectives with hatchery operations and harvest opportunity. This balance is achieved by following the HSRG's (Hatchery Science Review Group) integrated program guidelines (HSRG 2004). The HSRG's integrated program recommendations include: 1) limit hatchery-origin contributions to 5% of the natural production, 2) a minimum of 10% of the wild returns in the hatchery broodstock, 3) maintain an effective population size of 500, and 4) a ratio of 0.70 or greater for percent of natural spawner brood divided by the sum of percent hatchery-origin spawners in wild and percent of natural spawner brood. The assumptions used to deliver adult return estimates are based on the HRPP spring Chinook program from 1993 to 2006 and anticipated survival and harvest improvements resulting from moving juvenile rearing into the Hood Basin from the Deschutes River (if comparative release studies show this is biologically beneficial). The spring Chinook smolt release strategy has decreased from 250,000 (as presented in the 1991 Master Plan) to 150,000, while the harvest objective has decreased from 1,080 to 318 hatchery fish. Wild production objectives were lowered in recognition of a greater habitat limitation than recognized in the 1991 Master Plan (O'Toole and ODFWa).

The proposed escapement and harvest objectives (Table 10) not only consider the effects of revising HRPP spring Chinook rearing strategy, but also incorporate 10 years of data collection and analysis. Coccoli (2004) and Underwood et al. (2003) consider the spring Chinook carrying capacity of the basin and discovered that the HRPP's proposed target of 24,000 naturally-produced smolts exceeded the subbasins estimated carrying capacity of ~16,000 smolts. The new target was set at a natural production 15,000 smolts; which was based on current survival assumptions and the assumption that 15,000 smolts would need to be produced annually to achieve naturally-produced adult return objectives. Co-managers anticipate achieving higher survival rates than those observed from 1996 to 2006 once the benefits of in-basin rearing are realized. For example, the 1991 Master plan assumed a 0.68% smolt-to-adult SAR. The revised objective is 0.40% for hatchery and 2% for wild fish. The previous 0.68% SAR for hatchery fish was based on the survival rate of Round Butte stock spring Chinook returning to Round Butte Hatchery, which ranged from 0.09 to 1.47% for the period from 1986 through 1996 (ODFW and CTWSR Undateda). After review of other spring Chinook hatchery performances in the lower Columbia River system, a 0.4% SAR is more likely (USFWS 2007). It was assumed that with one less mainstem dam to negotiate, the Hood River spring Chinook should be able to survive as well or better than the Deschutes River spring Chinook. The HRPP observed a range of hatchery SARs (ages 3-6) from 0.01% to 1.2% and a ten year average of 0.3% and median of 0.16% (Olsen 2007). During the same period within basin wild smolt production estimates were not robust and the expected wild survival rate is based on the Wind River (USFWS 2007).

Table 10: Summarization of Harvest and Escapement in the Hood River Subbasin (Olsen 2007) and the HRPP's Program Objectives

Year	Hood River Escapement	Hatchery		Natural Spawners	
		Brood	Harvest	Hatchery	Natural
1999	87	17	0	70	23
2000	148	0	0	148	64
2001	1,050	134	130	920	41
2002	1,041	149	118	923	70
2003	326	0	0	326	101
2004	260	110	0	260	136
2005	648	162	39	609	111
2006	926	233	0	926	298
Average	**561**	**101**	**36**	**523**	**106**
1991 Objective	**1,700**	**220**	**1,080**	**400**	
Proposed Objective	**900**	**200**	**318**	**205**	**8**

In 1993, Round Butte hatchery stock from the Deschutes River replaced the Carson stock, altering the philosophy of the Hood River Chinook program from harvest only to a reintroduction program. Round Butte spring Chinook were believed to be more closely related to the extinct Hood River stock than the hybridized Carson Stock (Cramer 1991). The Hood River did not contain adequate rearing facilities and so rearing of Round Butte stock occurred at Round Butte Hatchery in conjunction with the Pelton Ladder (O'Toole and ODFWa).

Co-managers believed that if Round Butte stock did give rise to a wild stock in the Hood River, then the PFF would be expanded to allow for spring Chinook rearing. The pilot program was considered a success, and although HRPP's biological fish objectives have not been attained (Table 10), the program has continued to increase the wild and hatchery adult returns even during a period when ocean survival has been low.

Although hatchery spring Chinook did successfully return to the Hood River, they have also exhibited high precocity and straying rates which undermined the success of the program (Underwood et al. 2003, Olsen 2007). Precocity appeared to be linked to past over-feeding resulting in the release of smolts at 10 to the pound. Since Round Butte hatchery began limiting food in 2001, the precocity rates appeared to be dropping, but resurged in 2007. Precocity rates were 33%, 9.6%, 16, and 45% during 2004-2007 (Olsen 2007, Chris Brun, Pers. Comm.). The straying was believed to be a result of rearing the fish out of basin, because a majority of the stays returned to their natal Deschutes River. Although mixing of Deschutes and Hood River production groups in Pelton ladder may be a significant confounding factor in the interpretation of the data set used to arrive at this hypothesis.

Furthermore, Underwood et al. (2003) identified fish health as a potential limitation. Juvenile spring Chinook are reared to smolt stage in the Pelton Ladder. The water source for Pelton Ladder is Lake Billy Chinook, a reservoir known to contain kokanee and other fish with BKD. Up to 68% of the spring Chinook in the Pelton Ladder were infected with BKD (Underwood et al. 2003). In response, Round Butte Hatchery began culling BKD positive females, which has lowered the incidence in juvenile fish. However, on occasion, such as in the spring of 2008, juveniles continued to have high mortality rates at Pelton Ladder due to BKD and C. shasta (C. Brun, CTWSR, pers. comm.). These constraints may be reduced by rearing fish within the Hood River Basin at the PFF (pathogen-free spring water) and the proposed Moving Falls facility.

Assuming the comparative release study determines that in-basin rearing of spring Chinook is feasible and biologically favorable (see Section 3.3 and 6.1 for details), rearing fish within the Deschutes River would be discontinued, thereby eliminating the potential for imprinting on Deschutes River water. The Hood River and water sources associated with proposed Hood River rearing facilities are much cooler than Round Butte and Pelton Ladder water. Cooler water will reduce fish growth and reduce precocity rates. Larson et al (2004) discovered water temperature has a role in precocity rates, demonstrating that cooler water results in lower precocity as long as the fish were not overfed. The proposed facilities would use well and spring water during early life stages and filtered surface water during older life stages to reduce contraction of disease. New facilities would not reuse water to reduce disease transmission. Pelton ladder passes water over three rearing cells, allowing for disease transmission to downstream rearing groups.

3.2 Production Program Alternatives and Criteria

While developing the Master Plan, five primary alternatives were considered. With the exception of the status quo, all alternatives are based on the preference for in-basin rearing. All of these alternatives assume that the results of the comparative rearing and release study (testing the performance of rearing 50% of juveniles at Round Butte, 30% at Carson Hatchery and 20% at PFF) will indicate in-basin rearing of spring Chinook is feasible and preferable. The comparative release study is presented in Section 3.3 as the preferred short-term production program.

The following alternatives are for long-term production, and the presumed long-term alternative (Section 3.4) would be implemented following implementation of the short-term alternative (comparative release study). Assuming the results of the comparative release study indicate that in-basin rearing is feasible and biologically favorable and cost-effective, then the four alternatives for long term production include:

1) Employ the revised production guidelines and use existing rearing strategies (status quo).
2) Produce the maximum number of spring Chinook given the existing infrastructure constraints at the PFF.
3) Retrofit the PFF to achieve the HRPP's proposed production guidelines.
4) Develop alternative new facilities.

These alternatives were analyzed for the capability to achieve the co-manager's management goals with a reasonable likelihood of success, considering program costs and program logistical support.

3.2.1 Criteria

The criteria and assumptions outlined in Table 11 were incorporated into a "BioProgram" to identify which alternatives were likely to meet the program's release and size-at-release criteria. These criteria reflect husbandry practices designed to produce high quality hatchery spring Chinook as described by IHOT (1994), HSRG et al. (2004), and the NPCC Scientific Principles. The best husbandry practice for spring Chinook included rearing fish in a density index no higher than 0.16 lbs/ft^3/in up to a size of 15 fish per pound prior to smolt release, and hold returning adults in containers that provide 6 ft^3 per fish and 1 gpm per fish. Hatchery facilities that employ these practices are believed to produce high quality fish with minimal environment or stress related effect. The "BioProgram" is an HDR/FishPro model used in designing hatcheries.

Table 11: Criteria and Assumptions used in the "Bioprogram" to Determine Whether an Alternative was Consistent with Meeting Program Objectives

Program Criteria	Spring Chinook	Source
Adult Holding		
Holding depth (ft)	up to 8	NPTH 1998
Handling depth (ft)	3	NPTH 1998
Minimum length (ft)	50	NPTH 1998
Water flow/fish (gpm)	1.0	IHOT 1994
Pond space /fish (cuft)	6	IHOT 1994
Date start	15-Apr	Olsen 2004
Date end	30-Sep	Depends on maturation rates
Fecundity	3,320	Jim Gidley
Rearing General		
Fish length at swim-up (inch)	1.27	Piper et al. 1982
Fish per pound at swim-up	1,615	Senn et al. 1984
Condition factor	2.96E-04	Piper et al. 1982
Temperature. units per inch growth	884	Based on observed growth rates at PFF and anticipated fish size per Jim Gidley 3/15/07
Minimum positive growth temperature (Fahrenheit)	38	Piper et al. 1982. (jm and butch)
Fish per pound at transfer	300	Dependent on Alternative.
Feed conversion (lb feed/lb growth)	1.6	Warm Springs Hatchery HGMP
Size at release (fpp)	12	Hood River Managers
Early Rearing		
Density Index (lbs/cuft/in.)	0.16	Warm Springs Hatchery HGMP
Flow Index	>7ppm	Assumed.
Final Rearing		
Density Index (lbs/cuft/in.)	0.16	Warm Springs Hatchery HGMP
Flow Index	>7ppm	Assumed
Incubation - vertical stack		
Eggs/tray	3,320	One female/tray
Inflow (gpm)	4	Jim Gidley
Survival Rates		
% Adults needed to ensure coordinated maturation/BKD loss	18%	Jim Gidley
Pre-spawn adult holding	10.0%	Jim Gidley
green egg to eye	15.0%	Jim Gidley
eyed egg to fry	2.0%	Jim Gidley
fry to smolt total	10.0%	Jim Gidley

3.2.2 Status Quo

Spring Chinook reared at Round Butte Hatchery and Pelton ladder, as previously described in Chapter 2, express high rates of jacking and mini-jacking, disease, and straying which results in a diminished SAR. Maintenance of the status quo was therefore rejected.

In response to poor hatchery fish performance, the managers at the Round Butte Hatchery have reduced fish growth by limiting feed in order to release smaller smolts (Palmer, ODFW, 2008, pers. comm.). They have reduced the incidence of BKD by culling adult females that test positive for the disease; and added cleaning systems in Pelton Ladder to improve water quality and decrease disease. These actions have resulted in fewer disease outbreaks; however, in spring 2008, spring Chinook in the Pelton ladder showed high mortality from BKD and C. shasta (C. Brun, CTWSR, pers comm.). Straying is thought to be from CWT fish escaping out of the Pelton ladder into the Deschutes River that were destined for release in the Hood River and/or due to poor imprinting to the Hood River (Underwood et al. 2003). The true reason for the measured straying is not known, but fish with unique marks in one cell have been observed in the downstream cells of Pelton Ladder affirming the hypotheses that fish can move among cells and perhaps into the Deschutes River.

Additional shortcomings of the status quo alternative include violation of the HSRG guidelines and Oregon fish policy recommendations for integrated programs to rear fish within the basin of release (Hayes 2002, ICTRT 2007). Moving the rearing program to in-basin facilities would likely result in significant improvements in SARs by lowering mini-jack and jack rates, lowering incidence of disease, as well as producing smolts with similar sizes to their wild counterparts, thereby reducing the potential for hatchery fish to successfully out-compete wild fish (Pascual et al. 1995, Dittman et al. 1996).

3.2.3 Maximum Number at Current Parkdale Fish Facility

The PFF is limited by water and rearing space. Roughly 37,000 spring Chinook smolts could be reared to smolt size at the PFF without major infrastructure alterations. Assuming a 0.4% smolt-to-adult return (SAR) this program would produce 148 adults, falling far short of the escapement (600) and harvest (318) objectives. As a result, this alternative was rejected.

The PFF is designed to hold adult spring Chinook and winter and summer steelhead for egg collection and to acclimate and volitionally release spring Chinook and winter steelhead smolts. Spring Chinook adults are held at the facility from April to October. Summer steelhead adults are held year-round due to their prolonged run timing and freshwater residence, while winter steelhead adults are typically held only from January through June. The adult holding facilities provide more than sufficient space; however, they are subdivided to enable separation by gender and degree of maturation. Spring Chinook and winter steelhead juveniles are acclimated in two groups (15,000 per group for winter steelhead and one group of 30,000 for spring Chinook). Spring Chinook are acclimated in one of two raceways between March and approximately April 15 and winter steelhead are acclimated in the other raceway during April and May.

The PFF holds a surface water right of 2,508 gpm from Rogers Creek and Middle Fork combined with no filtration other than a fine mesh screen. Rogers Creek is spring fed and stays at a relatively constant temperature varying between 40 and 42.5°F. Rogers Creek runs clear year round and is fish pathogen free. However, the cool water temperature is lower than desired, and as a result Middle Fork water is mixed with Rogers Creek to increase water temperature in the spring, summer, and fall. Middle Fork water temperature ranges from 32°F in the winter to 55°F in the summer, but contains high total dissolved and suspended solids load because of glaciers and frequent rain on snow events. The high solids load and potential for the unfiltered water to contain pathogens makes this source of water undesirable.

Figure 5 presents the existing PFF, which has two adult holding ponds (1,280 cubic feet each), eight incubation stacks (only seven are currently used) with 8 trays each, two Canadian troughs (189 cubic feet each - not currently operational), and two raceways for juvenile rearing (2,560 cubic feet each). Due to flow restriction to the incubation room, only seven of the eight existing stacks can be operated simultaneously. In addition, copper piping was installed in the incubation building during construction. Copper is acutely toxic to salmonids, and is believed to upset olfactory function, and potentially homing (Barry et al. 2000). In response, the piping was coated and water tests have not detected copper ions (C. Brun, CTWSR, pers comm.).

The HDR/FishPro "BioProgram" was applied to this facility to translate the biological needs of spring Chinook, in addition to the on-going steelhead holding and incubation, for the purpose of developing engineering designs for a PFF facility that could accommodate all necessary production, both for spring Chinook and steelhead. The program has three components, which mimic the operation of "typical" salmonid propagation facilities including:

- adult holding;
- incubation; and
- early and final rearing (including acclimation).

As a result of the Bioprogram analysis, it was determined that water quality issues relating to siltation in the Middle Fork, and temperature in Rogers Creek severely limited the PFF's potential to accommodate the full production of spring Chinook (along with existing steelhead holding and spawning). Groundwater supplementation was possible; however, a new groundwater well tested during the development of this Master Plan produced an insufficient volume to rear all the proposed juveniles past the fry stage, and the well's water was a lower temperature than desired. Appendix G describes the result of the sustained production test.

Initially, evaluations were conducted to determine whether spring Chinook adult holding, spawning and incubation, fry rearing, and juvenile rearing to smolt release would be possible at the PFF with no modifications, using only surface water from Rogers Creek. In short, the lack of fry rearing facilities precluded spring Chinook production. However, if the existing Canadian troughs were installed and plumbed, approximately 37,000 spring Chinook smolts could be produced without impacting existing functions at PFF. If existing spring Chinook acclimation were retained at the PFF, the juvenile spring Chinook produced at the PFF would have to be released on March 15 at approximately 21 fpp or moved to an offsite acclimation facility.

Minor upgrades would be required such as plumbing in troughs, the addition of a heater to allow for spring Chinook incubation, and replacement of copper piping. However, no significant modifications or additions would be required, and no additional water would be required. Rearing greater than 37,000 smolts at PFF would require additional early rearing space and potentially increases in on-site final rearing space, additional water and/or the development of off-site acclimation facilities.

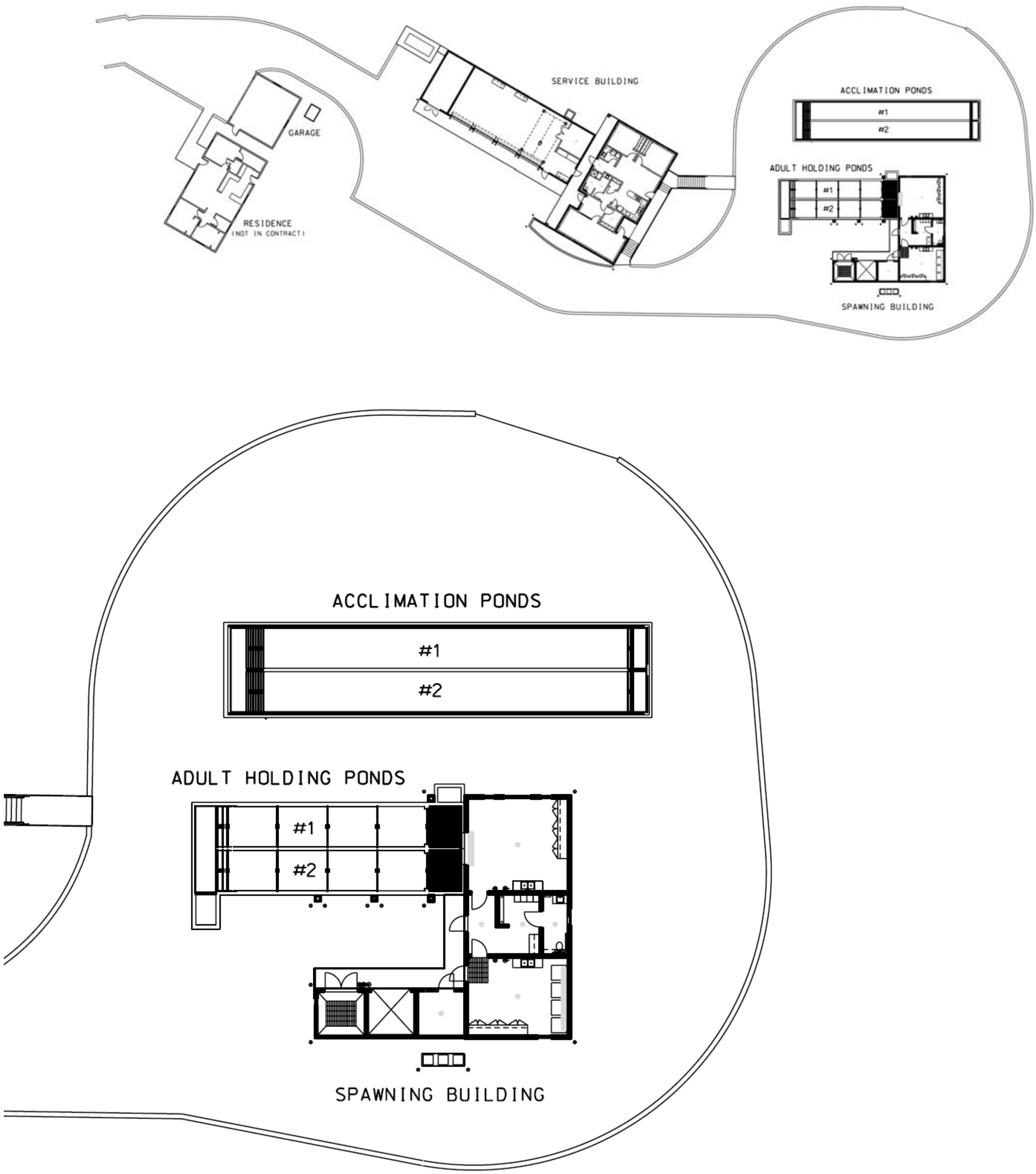

Figure 5: Site Plan for the Existing Parkdale Fish Facility with Enlarged Detail of the Spawning Building, Adult Holding and Acclimation Facilities

3.2.4 Retrofit Parkdale Fish Facility

In 2002, the CTWSR conducted a feasibility study to determine required upgrades at PFF in order to rear 125,000 spring Chinook to smolt size while continuing the other program activities (i.e. adult holding, smolt acclimation). The proposed expansion considered the development of early rearing facilities, including raceways, ponds, and associated infrastructure (MWH 2002). One well was drilled and tested in hopes of augmenting available water. The study determined that existing water resources were insufficient to provide for rearing 125,000 fish to smolt size and that additional water, in the form of ground or surface water, would be required to accommodate such rearing. The wells did not produce sufficient water to warrant development. Water quality issues relating to the high silt content of the glacially-driven Middle Fork also limited the potential use of the tributary. Finally, the preferred water source, Rogers Creek, which is pathogen free and lacks siltation issues, has relatively cool surface water temperatures that could present problems related to the HRPP's growth and size at release criteria (Piper 1982).

The CTWSR drilled two additional wells in response to the feasibility study. These wells were untested for sustainable output until development of this Master Plan. The wells produced 280 gpm sustained yield, which is roughly 700 gpm short of the water needed to rear the proposed 150,000 spring Chinook smolts. The wells also produced cooler than desired water (44°F). The CTWSR desire the capability of warming the water to 48°F. There was hope that the new wells would produce water at 50°F; however, the new wells produced 44°F water. The cooler water was considered an impediment, because egg and fry growth would be slowed to the point where the 15-18 fpp criteria would not be met and mortality may increased during the conversion from the yolk sack to feed (J. Gidley, CTWSR, pers comm.). If the water is too cool, the fry will not readily convert to feed and disease such as pinhead dropout would likely be expressed.

Rearing spring Chinook from egg-to-smolt in the Middle Fork also presents a homing and adult return problem. The co-mangers are working towards the reintroduction of spring Chinook into the West Fork Hood River. Rearing spring Chinook to near smolting age and then moving them to acclimation facilities in the upper West Fork would probably result in poor affinity for the West Fork and would require additional facilities in the upper West Fork for acclimation. Hence, spring Chinook would be reared in the Hood River subbasin, but straying among Hood River forks is more likely under this scenario (yet far less likely than under the current rearing practices). Although fish would be returning to the Hood River, returning adults would likely have a stronger affinity for the Middle Fork over the West Fork making the West Fork reintroduction and fishery less successful.

The Middle Fork contains limited spring Chinook habitat and would not produce a wild adult return of a size large enough to be deemed healthy (500 individuals or greater; HSRG 2006). The Middle Fork Hood River is a very dynamic system prone to significant ice jams and debris flows. One such debris flow occurred as a result of flooding in November 2006. The flood flow of this event was high enough to carry debris comprised of whole trees and boulders larger than eight feet in diameter. The transport of this debris flow down the valley had a significant impact on the surrounding areas and put structures, including the PFF, at risk. The Middle Fork bridge crossing on Red Hill Drive and adjacent to the PFF was destroyed and the majority of the flow of the Middle Fork was diverted from its pre-flood channel into a new channel that is encroaching on land within the boundary of the BPA-owned PFF. To address this channel migration and the potential risk to the PFF, BPA contracted with HDR/FishPro to develop a feasibility study to determine how the hatchery could be protected from future channel dynamics. The results of the study are presented in Appendix H. Funding has recently been secured from BPA to create a berm to protect the hatchery from further encroachment by the Middle Fork. However, a berm cannot protect against a future debris flow, only flooding.

In consideration of the information presented above, the co-managers determined that a large-scale expansion of the PFF to provide for full rearing of the HRPP spring Chinook program was not the preferred alternative. However, because the PFF currently is equipped to hold, spawn, and incubate spring Chinook and steelhead, minor modifications to the existing infrastructure would allow for continued use of the facility, while providing some spring Chinook rearing capabilities. Such improvements were considered in the preferred alternative.

3.2.5 Develop Alternative New Facilities

The PFF currently does not have sufficient water to meet the HRPP's proposed release guidelines and the facility may be in jeopardy if the Middle Fork experiences a catastrophic event similar to November 2006. As a result, new alternative facility locations were explored. The exploration was limited to the West Fork Hood River. Rearing fish on West Fork water would improve return affinity to the West Fork where the program is attempting to reestablish natural spawning and maintain a robust fishery. Three alternatives were considered: 1) use an existing privately owned facility (Dee Hatchery), 2) construct a new facility at Moving Falls, and 3) contract Carson National Fish Hatchery (not in basin). The following describes those alternatives in greater detail.

Sub-Alternative 1: Use of Existing Dee Hatchery

Dee Hatchery is located in the vicinity of Punchbowl Falls on the West Fork Hood River. This facility is owned and operated by Trout Lodge. The Dee Hatchery was audited and was identified as having sufficient space for the program's target production of 150,000 smolts. However, the available water supply was limited due to seasonal demands for surface water by irrigators. Assuming the Dee Hatchery was available for purchase or lease, co-managers evaluated three sub-alternatives regarding use of the facility:

1. Move all spring Chinook functions, including spawning and incubation, from the PFF to the Dee Hatchery;
2. Maintain adult holding, spawning and early rearing at the PFF and transfer approximately half of the PFF production to the Dee facility at swim up; and
3. Use the "smolt purchase" option whereby fish are transferred from PFF at swim-up to the Dee Hatchery and reared in circulars and raceways before direct release at Moving Falls.

For any of the above sub-alternatives to be viable, extensive upgrades would be required to accommodate spring Chinook production. As shown in Table 12, upgrades to the existing surface water intake and distribution system, UV system, pump facility, and hatchery building would be necessary. Under all sub-alternatives, the surface water requirements exceeded that available at the Dee Hatchery. Costs associated with acquiring additional surface water are prohibitive. Additionally, this facility is located on a small tributary to the West Fork which is fed by several lakes in the upper basin. As these lakes are stocked with sporting fish, this tributary is prone to disease issues and has a high occurrence of BKD (Bullock and Herman 1988). In summary, disease combined with costs and limited water quantity precluded further consideration of these alternatives.

Sub-Alternative 2: Moving Falls Rearing Ponds

Sub-alternative 2 considers the development of a new facility to provide for complete in-basin rearing of spring Chinook. Under this alternative, new rearing ponds would be constructed on the west bank of the West Fork in the vicinity of Moving Falls, immediately adjacent to the proposed floating weir and adult trapping facility (see Chapter 4). Under this scenario, juveniles would initially be reared in troughs at the PFF, and would then be transferred to new concrete raceways at the Moving Falls site. The raceways would be installed on a bench formed from excavation spoils deposited during the installation of grade controls to prevent undercutting and to facilitate fish passage on this reach of the West Fork (Pictures). This facility would be designed to accommodate the full spring Chinook production (150,000 smolts).

The development of the Moving Falls Rearing Ponds makes biological sense. Spring Chinook naturally spawn and rear in the West Fork; therefore, rearing Chinook on West Fork surface water as opposed to Middle Fork water at PFF would better mimic West Fork conditions and give rise to fish with higher fitness and fidelity. Rearing fish on West Fork water will also mimic rearing conditions in the natural environment compared to the Middle Fork, which is cooler. In addition, rearing fish at this location also makes economic sense since the facility would tie into existing infrastructure and operation of acclimation ponds would not be required. Additionally, because the proposed adult trap and floating weir would be located immediately adjacent to the facility, there would be less cost associated with temporary holding and in-basin transfer. A comparison of these sub-alternatives is presented Table 12.

Sub-Alternative 3: Rear at Carson National Fish Hatchery

Carson National Fish Hatchery is located in the Wind River Subbasin across the Columbia River and downstream from the Hood River. This hatchery was built in 1937, then remodeled in 1956 to establish a hatchery spring Chinook run in the Wind River. The primary water supply for this facility is from a spring fed creek that produces 46°F water year round. The Carson hatchery produces 1.42 million spring Chinook smolts at 17 fpp. The hatchery fish have a 10 year average SAR of 0.67, with no mini-jacks, and 1% jacks. Four or five year old returns dominate (USFWS 2007). This hatchery has sufficient space to rear fish for the Hood River program and is expected to produce a high quality Hood River fish, if used in this capacity.

Table 12: Alternatives Matrix for Spring Chinook Rearing Alternatives

Alternative	1	2	3	4-Perferred Short Term	5 - Presumed Long Term
Description	Parkdale Rear All	Dee Hatchery Purchase & Retrofit or Purchase Smolts	Moving Falls Rearing Ponds	Round Butte, Carson, Parkdale and Moving Falls	Moving Falls Rear All & >25% Production at Parkdale
Egg Collection	Parkdale	Parkdale	Parkdale	Parkdale	Parkdale
Early Rearing	In troughs at Parkdale	Move to Dee at swim-up and rear in circulars	In troughs at Parkdale	At each rearing facility. See Smolt Production.	Move all or portion to Moving Falls at swim-up
Late Rearing	Raceways at Parkdale	Raceways at Dee	Raceways at Moving Falls	At each rearing facility. See Smolt Production.	Raceways at Moving Falls & Parkdale
Smolt Release	Direct release at Moving Falls	Direct release at Moving Falls	Direct release at Moving Falls	Direct release (forced) at Moving Falls	Direct release (forced) at Moving Falls
Property Control	None	None	Land use agreement	Land use agreement	Land use agreement
Smolt Production	75,000	150,000	150,000	75k Round Butte 45k Carson 30k Parkdale	150,000 Moving Falls
Action Required	Add early rearing troughs, final rearing raceways (1 pair), drain piping, cleaning waste	Dead Point Creek intake upgrade, intake supply line upgrades, water distribution system to raceways, hatchery building upgrades, UV system & filtration, West Fork pump facility infrastructure	Concrete raceways, predator netting, outlet fish release, UV system, surface water supply, site work	**Moving Falls:** surface water supply and site work **Parkdale:** improve drain piping water heater and plumbing in incubation room, pipe early rearing tanks	**Moving Falls:** concrete raceways, predator netting, outlet fish release, UV system, surface water supply, site work **Parkdale:** improve drain piping water heater and plumbing in incubation room, add early rearing tanks
Land Cost	None	150,000 – $2M	Unknown – easement	Unknown – easement	Unknown – easement
Infrastructure Cost	$588,676	$820,000 – $2.2M	$1,833,750	$435,000	$2,145,021 (assumes alt 4 completed prior to this step)
Total CAPITAL Cost	**$588,676**	**$970,000 - $4.2M**	**$1,833,750 + easement**	**$435,000 + easement**	**$2,145,021 + easement**
UV/ Pump Ops Costs	$18,024	$10,000	$5,175	$11,000	$20,000
Annual Maintenance	$3,840	$12,000	$4,677	$3,840	$8,517
Total EXPENSE Costs (annual)	**$21,864**	**$22,000**	**$9,852**	**$14,840**	**$28,517**

The drawback to this approach is the fish would be reared out of basin and therefore may exhibit high propensity to stray, similar to Round Butte Hatchery fish. However, the cooler temperatures and clean water source could solve problems experienced at Round Butte and Pelton Ladder with disease and jacking.

3.3 Preferred Short Term Alternative

Prior to employing the presumed long-term alternative from the options previously considered, the HRPP will test the efficacy of rearing spring Chinook at three different sites: Round Butte, Carson, and Parkdale. Co-managers are concerned that full production at the PFF and an unproven new facility that is subject to extreme weather conditions (Moving Falls) may not initially be as successful as rearing at existing facilities. Therefore, co-managers propose a comparative hatchery release evaluation (Table 13) that compares the size at release, precocial maturation, and SARs of spring Chinook released in the Hood River Basin that are reared at one of three facilities: 1) the Round Butte Hatchery / Pelton Ladder in the Deschutes Basin (OR); 2) the Carson National Fish Hatchery in the Wind River drainage (WA); and; 3) the PFF in the Hood River Basin. Details regarding this comparative study are presented in Chapter 6.

Table 13: Proposed HRPP Spring Chinook Salmon Comparative Release Strategy[1]

Facility	# Reared	Life Stage Delivered To Acclimation Site	Type of Release
Round Butte Hatchery / Pelton Ladder	75,000	Pre-smolt	March-April Acclimation –Forced Release
Carson National Fish Hatchery	45,000	Pre-smolt	March-April Acclimation –Forced Release
Parkdale Fish Facility	30,000	Pre-smolt	March-April Acclimation –Forced Release

[1] Juvenile rearing will begin in brood year 2008 with smolt releases in 2010. Eggs would be collected from the 2008-2013 broods to be raised at each facility. The final release would occur in 2015. Results would be evaluated after the return of age 5 adults from the 2008 brood in 2013.

The results will provide the necessary information for co-managers to determine a long term, biologically sound, and cost effective spring Chinook production strategy for the Hood River Basin that balances harvest with ecological considerations. The objective of this evaluation is to provide managers with the information necessary to determine the most cost effective approach (or combination of approaches) for: 1) rearing HRPP spring Chinook smolts to an average size of 15-18 fpp at release; and 2) increasing the average adult SAR to 0.4%. If the results of the trial determine that in-basin rearing is truly the most effective rearing strategy, the preferred long-term production alternative would be implemented; otherwise, the status quo would be maintained. Under this alternative, described in detail in Section 3.4, all spring Chinook rearing would be transferred from the Pelton Ladder and Round Butte Hatchery in the Deschutes River to one of two facilities in the Hood River Basin. The Moving Falls facility is a new rearing facility proposed to be located on the west bank of the West Fork, adjacent to the proposed weir location near Moving Falls. This facility would rear up to 100 percent of the HRPP spring Chinook, while the remainder would be reared at the PFF, which would undergo minor upgrades, including the addition of several new wells. Infrastructure for the Moving Falls facility would be installed during weir construction at the site. The test phase would require the following infrastructure improvements that are described in more detail in for following section: 1) construct a 4cfs intake structure at Moving Falls for acclimation of spring Chinook smolts; and 2) pipe a well to Parkdale Hatchery for egg and early rearing.

3.4 Presumed Long-Term Alternative — Minimal Parkdale Upgrades and Construct Moving Falls Rearing Facility

The presumed long-term alternative describes what is believed to be the best balance of improving SARs, providing reasonable harvest levels, and balancing costs. However, what is presented here may be altered based on information gathered during implementation during the short term alternative (5 years). The long-term alternative requires minimal upgrades to PFF and the construction of a new facility at Moving Falls with concrete raceways. Under this alternative, either all or a portion of fish hatched at the PFF would be transferred to Moving Falls at 300 fpp fry, reared to 15 fpp and force-released. If the complete production were not transferred to Moving Falls, a portion (up to 25%) of the production would remain at the PFF for rearing until release, when they would be transferred to and released from Moving Falls. Minor modifications would be required at the PFF to allow for implementation of this alternative. This alternative would include the components described below.

3.4.1 Parkdale Fish Facility

Proposed for 2009:

- Add pump and plumb existing well to facility (early action).
- Re-plumb incubation building to increase flow and retrofit copper pipe with PVC or similar inert material.
- Develop wells and pipe to hatchery building and early rearing trough

Proposed for 2014:

- Plumb Canadian rearing troughs to allow for early rearing.
- Build Waste Treatment system.
- Install water heater to facilitate incubation well water.

3.4.2 Moving Falls

Proposed for 2009:

- Build intake structure with a 4 cfs water right and maximum capacity (early action).

Proposed for 2014:

- Build water filtration system to limit possible infection by diseases such as BKD.
- Build 6 raceways capable of rearing up to 150,000 smolts at 15 fpp with release.

3.4.3 Summary of Proposed Hatchery Practices

With regard to production numbers, the only changes proposed under this Master Plan are: 1) to increase the production release of spring Chinook smolts from 125,000 to 150,000 smolts, and 2) cessation of the hatchery summer steelhead program. Modifications to the winter steelhead program will be revisited in the future if deemed necessary by co-managers; however, no changes are proposed at this time in the size of the winter steelhead production release.

Modifications to current hatchery practices, including broodstock collection, are: 1) initiation of a comparative release study of spring Chinook to determine the potential for in-basin rearing; 2) upgrades to the PFF and construction of a new acclimation and rearing facility at Moving Falls on the West Fork; 3) continued use of only wild broodstock for winter steelhead unless such use requires more than 25% of wild population; and 4) installation of 2 new adult trapping facilities to replace the facility at Powerdale Dam.

A summary of the revised hatchery practices for spring Chinook, as well as for winter steelhead, are depicted in Figure 6 and Figure 7, below. The summer steelhead program is proposed to be discontinued, and therefore is not depicted in the figures.

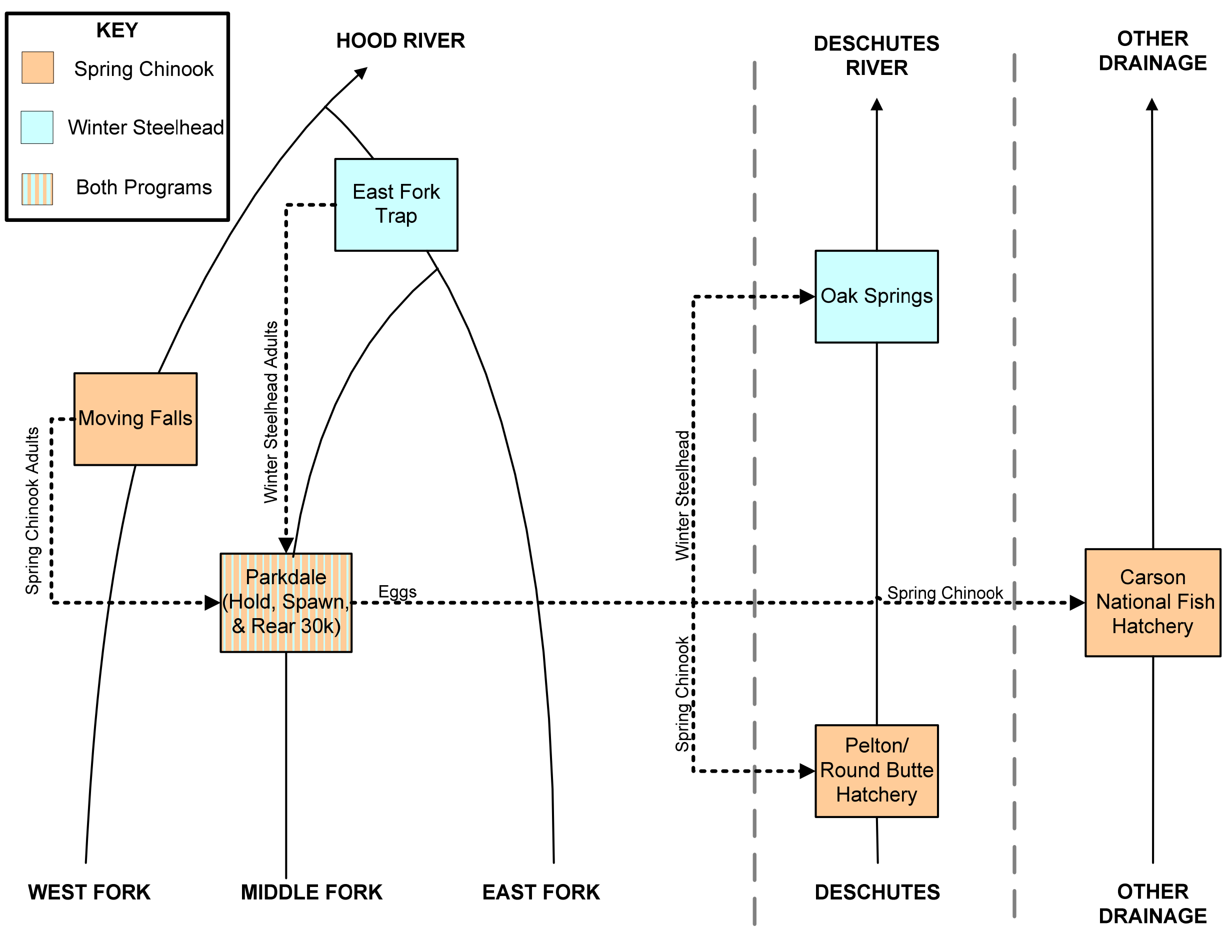

Figure 6: Revised Adult Program

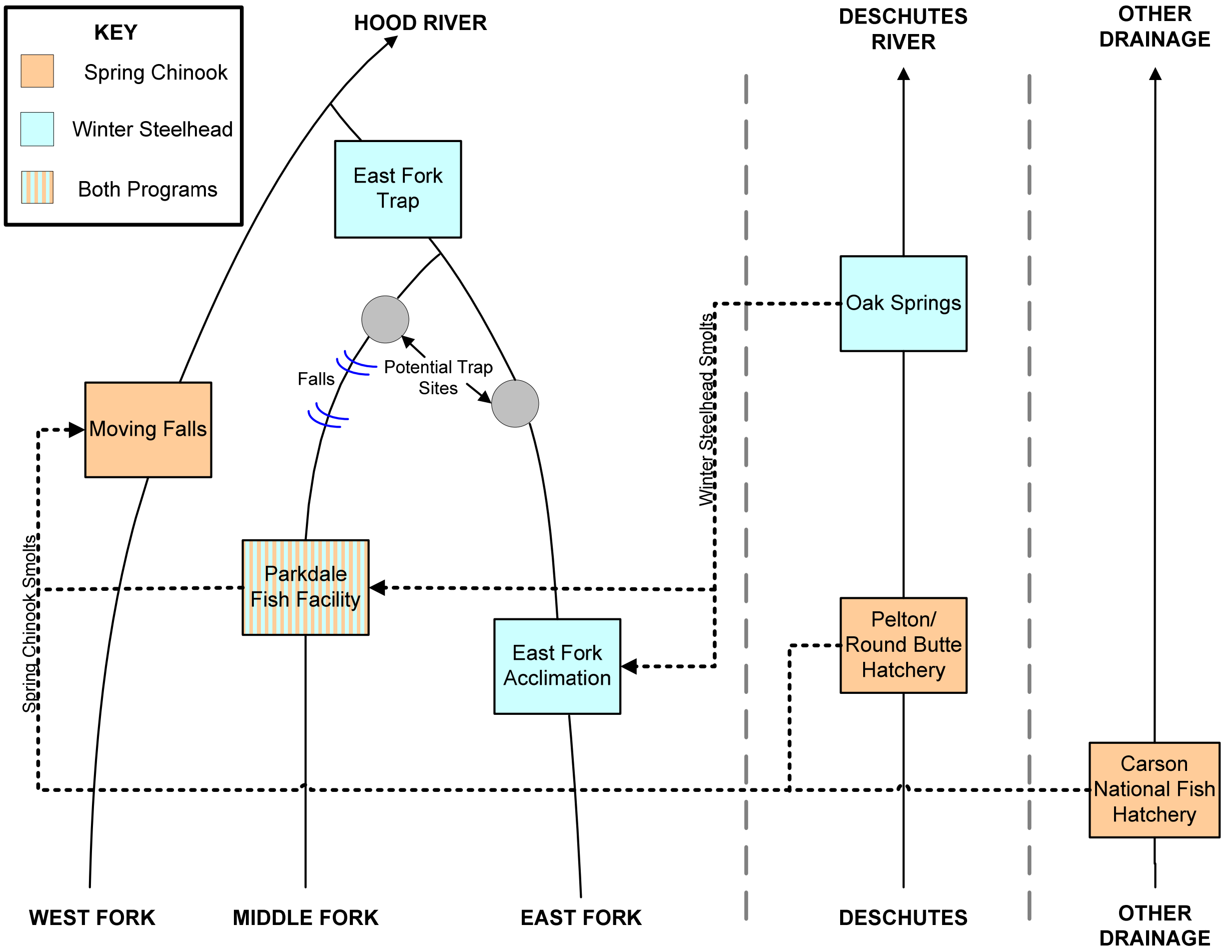

Figure 7: Revised Smolt Program

Broodstock Collection

With removal of the Powerdale Dam, broodstock collection would be accomplished at two new weir locations, one on the West Fork near Moving Falls and one on the lower East Fork downstream of the Middle Fork (Figure 6 and Figure 7). A complete discussion of the proposed trapping facilities, including an evaluation of sites investigated, is presented in Chapter 4.

3.4 Conceptual Design of Parkdale Fish Facility and Moving Falls Rearing Facility

3.4.1 Parkdale Fish Facility

The spring Chinook would be trapped at Moving Falls fish trap (see Chapter 4). The facility is designed to be 100% impassable for spring Chinook to ensure absolute control over the number of fish allowed to spawn naturally upstream of the barrier. Trapped spring Chinook would be interrogated and either: 1) released upstream, 2) moved to PFF for spawning, 3) moved back downstream for additional harvest opportunity, or 4) dispatched and distributed to CTWSR food banks. Winter steelhead collection and holding would be similar to the past program, except that they would be trapped at the new East Fork trap instead of Powerdale Trap (see Figure 11; Chapter 4). PFF currently contains two 8x40x4 raceways designed to hold up to 426 adults when applying a 6 ft^3 per adult criteria (IHOT 1994). The proposed program would not exceed 200 adults and therefore PFF contains adequate adult holding facilities.

The HRPP will maintain a monitoring program capable of predicting the number of wild and hatchery fish returning and available for the hatchery program (see Chapter 6). The HRPP will continue to conduct genetic analyses for winter steelhead prior to spawning to identify siblings and avoid sibling crosses.

The HSRG integrated program guidelines will be followed by using no more than 25% of the wild returning population as broodstock for the hatchery, provided sufficient numbers of fish return to achieve the minimum natural escapement objectives. No more than 5% of the hatchery-origin spring Chinook will be passed upstream of the trap. However, if after one generation (5 years) of following these guidelines the wild population is below the HRPP's escapement objectives and all available information suggests the wild population is in a downward trend, then the percent and number of hatchery spring Chinook passed above the barrier will be increased to reach the minimum escapement objectives of hatchery and wild fish combined. This activity will continue until the wild population builds to a level capable of sustaining the hatchery program and after two generations of program implementation (2018), the program will be re-evaluated to determine the efficacy of the spring Chinook program.

An existing well would be outfitted with pumps and plumbed to the facility to provide 44°F pathogen free incubate and early rearing water. Eggs would be incubated at the PFF in heath trays on 44°F well water with the ability to heat the water up to 48°F. Egg collection and incubation would occur at PFF and would require 60 heath trays based on a green egg to eye mortality of 15%, eyed egg to fry mortality of 2%, fry to smolt mortality of 10%, and a fecundity of 3,320. Table 14 provides additional information. The water heating system was calculated to require two heaters during egg incubation though early rearing. These heating units were sized to heat a maximum of 275 gpm from 44°F to 46°F. As a result, during egg incubation when no more than 45 gpm are needed, the heaters would be able to increase the water to roughly 50°F. The probable limitation to running the heaters would be the electrical costs. If the heaters are operated to meet the water flow requirements for incubation and early rearing only and water temperature of 46°F, then the annual electrical cost would be closer to $9,000.

The PFF contains a sufficient number of trays to incubate the number of eggs identified if the top tray is used. IHOT (1994) recommends not using the top tray to protect the eggs from the environment. As a result, two additional stacks would be added to the facility. The incubation room would also require re-plumbing to increase flow and retrofitting copper pipe with PVC or similar inert material

Table 14: Incubation Requirement Derived by the BioProgram

Egg and Incubation	Number
Green Eggs Required	199,011
Eyed Required	169,159
Fry Required	165,776
Brood fish collected	200
Females Spawned	60
Males Spawned	60
Fecundity	3,320
Trays Required	60
Stacks Required	9
Flow Required (gpm)	50

Fry would continue to be reared at PFF on heated well water until reaching the fingerling stage, which is roughly 300 fpp in late March. Early rearing would be conducted in troughs. The PFF has two troughs; however, 8 would be required. The 6 troughs and associated plumbing would be added to the facility. The fish would be moved to Moving Falls for grow out and volitionally released as 15-18 fpp in March to early April the following year.

Up to 25% (37,000 smolts) would be retained at PFF, grown to smolt size and released at Moving Falls or in the Middle Fork. The Middle Fork formed a partially impassable falls near the mouth of the fork during the November 2006 debris flow. As a result, Middle Fork releases are unlikely unless fish passage is provided. If Middle Fork is not fish passable then smolts may still be reared at PFF for experimental purposes.

Figure 8 provides a conceptual drawing of the PFF with the improvements described above. Table 15 summarizes the costs of these improvements totaling $746,271. The additional infrastructure would also increase operation costs. A large contributor would be the added electrical costs for the well pumps and water heating system, with annual costs totaling $20,000. The current PFF contains sufficient storage, maintenance, and administration space to achieve the proposed activities without improvements.

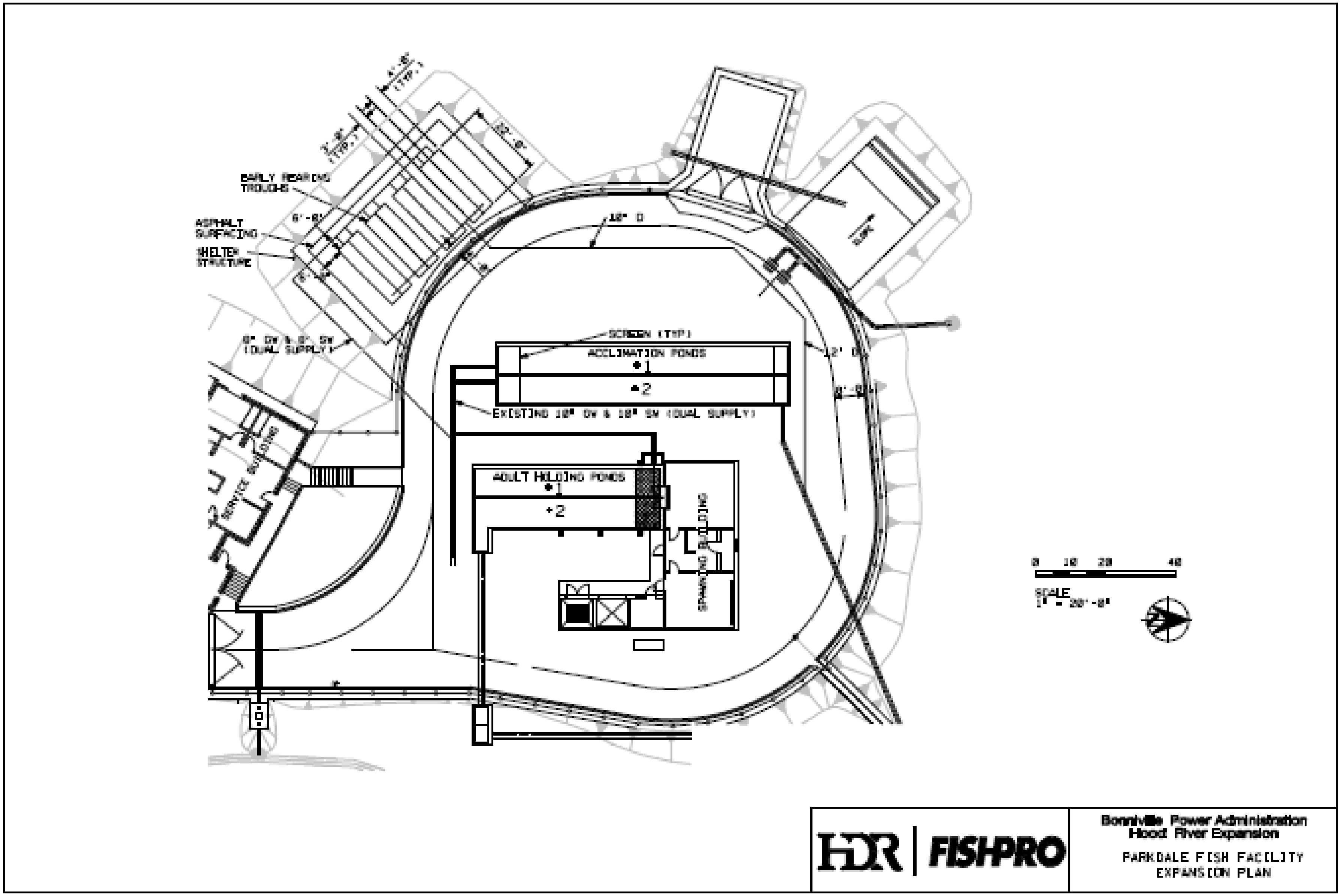

Figure 8: Parkdale Fish Facility with Conceptual Level Detail of Proposed Improvements

Table 15: Parkdale Fish Facility Improvement Costs

Item	Total
Well pump and piping	$125,000
Mobilization & demolition	$25,000
Repipe and add stack to incubation room	$30,000
Early rearing troughs	$208,914
Drain piping	$13,600
Cleaning waste treatment	$75,000
Heated water system	$20,000
Total with Estimate Contingency (25%)	**$621,893**
Engineering (15%)	$93,284
Permitting (5%)	$31,095
Total Project Cost	**$746,271**
Operating Electrical Costs	
Well pump costs	$11,000
Water heating costs	$9,000

3.4.2 Moving Falls Rearing Facility

Moving Falls would serve as a grow out and smolt release facility only (Figure 9), adjacent to the proposed trapping facility (Chapter 4). West Fork water would be collected at an intake structure upstream of the facility and delivered by gravity to a sterilization facility. Since salmonids with diseases such as BKD would be upstream of the intake structure, water would be sterilized prior to deliver to the raceways. Sediment filter, ultraviolet filter, and assist pumps capable of sterilizing up to 3 cfs would be the major components required to deliver clean water to the rearing spring Chinook. This facility would operate year-round. Fry reared at PFF would be delivered during March-April as smolts volitionally leave the Moving Falls Facility. Maximum water requirements would be during April at a little less than 3 cfs. The facility would be designed to 4 cfs to ensure adequate water and flexibility are provided.

Moving Falls is a remote site behind locked gates and therefore the public would not have access. Moving Falls is within land holdings of Longview Fibre, which has tentatively agreed to lease the site to BPA for the activities and infrastructure described herein. Six concrete raceways would be constructed on site and protected by a perimeter cyclone fence. Raceways would be plumbed with an outlet to allow for direct release. An on-site storage building will be necessary to house equipment and conduct fish tagging. No administration or maintenance buildings would be associated with this site. Those functions and activities would be conducted at the PFF where adequate building space currently exists.

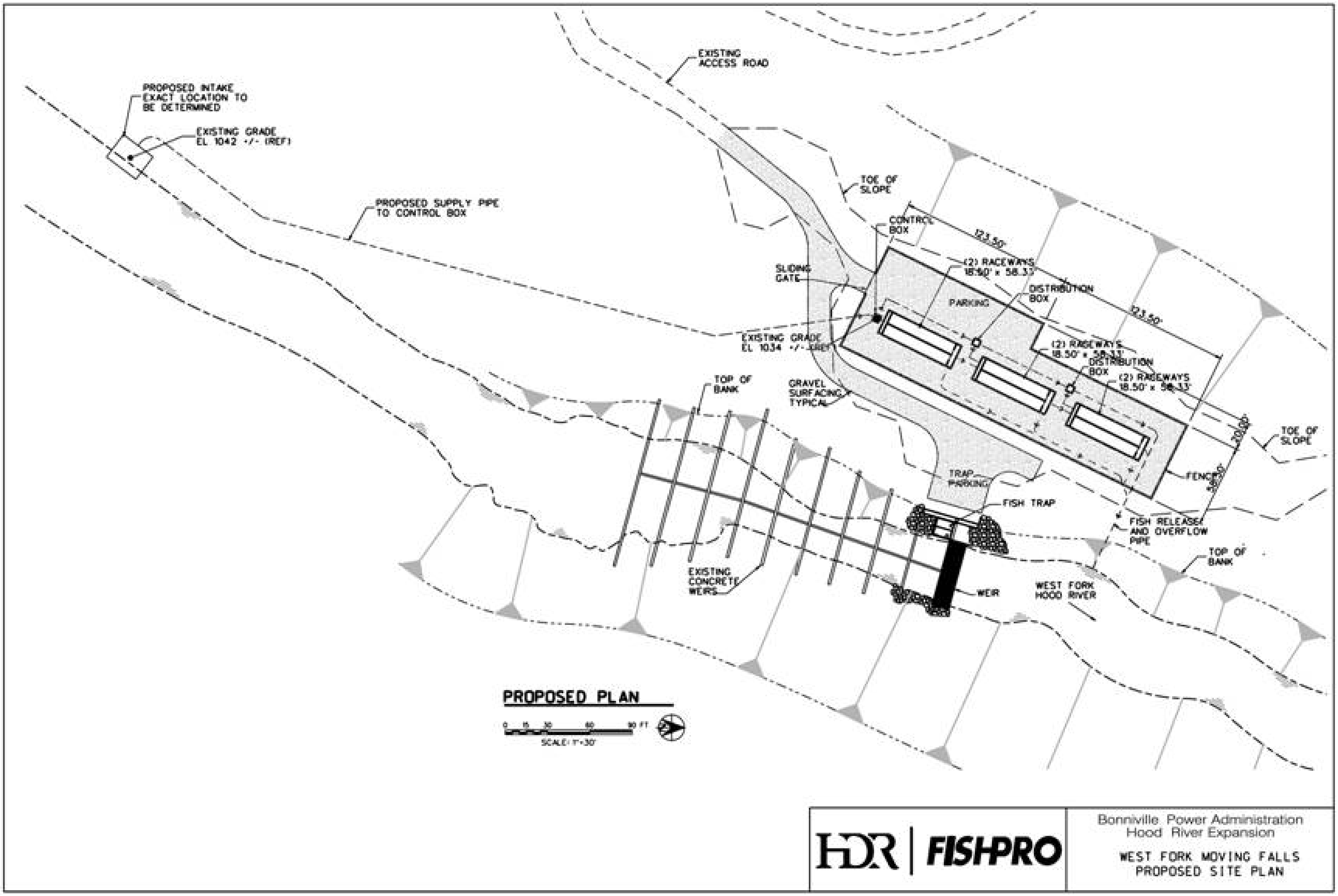

Figure 9: Moving Falls Facility with Conceptual Level Details of Site

Table 16: Moving Falls Projected Costs

Item	Total
Surface water supply (4 cfs)	$280,000
Raceway 6 (15'x4'x50')	$340,000
Predator netting exclusion system	$156,000
Outlet/fish release	$65,000
Site work	$61,000
Ultraviolet and filtration	$280,500
Power	$40,000
Subtotal with Estimate Contingency (25%)	**$1,528,125**
Engineering (15%)	$229,219
Permitting (5%)	$76,406
Total Project Cost	**$1,833,750**
Operating Electrical Costs	
UV filtration cost	$2,190

3.5 Coordination and Management Structure

The CTWSR would operate the PFF and the proposed Moving Falls rearing facility. PFF currently employs 2 full time employees who live on site, including a Hatchery Manager and Assistant Manager. Operation of Moving Falls Rearing Facility would require an additional part-time employee to monitor the intake, conduct daily cleaning of the six raceways, and provide daily feeding. The Moving Falls trap would be operated jointly by ODFW and CTWSR (see Chapter 4 for addition information).

3.5.1 Summary of preferred alternative conceptual design and costs

Of the alternatives considered, the preferred alternative – minimal Parkdale upgrades and Moving Falls rearing site development – is the least costly alternative ($2.5 million) with the potential to achieve all of the objectives of the program.

Table 17 summarizes facility components necessary to achieve the preferred alternative. This alternative would correct the problems of the current program by rearing spring Chinook within, instead of out side of, the basin. The change is expected to limit straying, improve adult return affinity to the West Fork, reduce jacking rates, and improve overall fitness. This alternative provides the infrastructure necessary to alter water temperature to accelerate or retard growth in an effort to reduce jacking, but ensures adequate survival during vulnerable periods of the spring Chinook's life such as button-up to feeding fry stages. Spring Chinook would be reared at Moving Falls for a majority of their lives ensuring the hatchery fish are subjected to thermal regimes of the wild fish within the West Fork. As a result, hatchery fish would be of similar size and smolt during a similar time period to the wild fish. These conditions would likely accelerate hatchery fish adaptation to the West Fork environment, giving rise to a viable wild Hood River spring Chinook stock.

Table 17: Water and Container Currently Available and Requirements for Preferred Long Term Alternative

		Current Condition	Preferred Alternative	
		Parkdale	**Parkdale**	**Moving Falls**
Smolts Release (#)	Spring Chinook	125,000	150,000	150,000
Release Size (fpp)	Spring Chinook	12-15	15-18	15-18
Water Supply (gpm)	Middle Fork	2,509 (combined)	0	0
	Rogers Cr.		2,509	0
	West Fork	0	0	1,795
	Well	0	275	0
Water Temp	Eggs	42-52°F	44-48°F	na
	Fry	No	44-48°F	na
	Rearing	No	42°F	36-51°F
Parkdale Rearing Space	Eggs	8 Stacks (64 Trays)	10 stacks (70 trays) top tray not used	0
	Fry	2 Troughs (3′x21′x3′)	8 Troughs (3′x21′x3′)	0
	Offsite Rearing	Round Butte	Moving Falls West Fork	na
	No. offsite	125,000	up to 150,000	up to 150,000
	No. Reared Onsite	0	up to 37,000	na
	Rearing	None	1 Raceway (8′x80′x4′)	5 Raceways (15x50x4)
	Smolt Acclimation	2 Raceways (8′x80′x4′)	1 Raceway (8′x80′x4′)	1 Raceway (15x50x4)
	Adult Holding	2 Raceways (8′x40′x4′)	2 Raceways (8′x40′x4′)	None
Parkdale Rearing Water (gpm)	Eggs	35	45	na
	Fry (300-200 fpp)	Round Butte	80	na
	Rearing (April 15)	0	280	1,296
	Offsite Rearing	Round Butte	0	0
	Smolt Acclimation	1,500	1,500	0
	Adult Holding	800	800	0
	Max Water Needed	2,335	2,660	1,080
	% of Available Used	93%	96%	83%

CHAPTER 4: PROPOSED TRAPPING AND COLLECTION ALTERNATIVES

4.1 Goals and Objectives for the Trapping Program

Co-managers of the HRPP evaluated alternative sites and methods by which broodstock collection and escapement monitoring could occur following the decommissioning of Powerdale Dam. After preliminary discussion focused on the concept of a single, combined trapping system in the mainstem Hood River that was capable of trapping all HRPP returning adults, it was determined that greater flexibility, lower environmental impact, and a lower cost approach was desired.

As a result, co-managers initially evaluated alternatives addressing the potential to install three barriers and traps, one each in the East, Middle, and West Hood River forks. This approach would allow maximum fish management flexibility and control with regard to separation of each HRPP stock with lower environmental impact. However, as discussions among the co-managers continued, the biological need and costs associated with three traps led to the idea of two traps, one on the West Fork, and one on the Lower East Fork downstream of the Middle Fork. Barrier and trapping strategies for each system are presented in Table 18.

Table 18: Trap Performance Goals for Each River

	West Fork	East Forks	East and Middle Forks
Management Priority	1	2	3
Location	Moving Falls	East Fork downstream of the Middle Forks	One in the East One in the Middle
Broodstock (min) Spring Chinook Winter Steelhead	 200 0	 0 64	 0 64
Capture Guidelines	Meet brood collection protocols and M&E needs	Meet brood collection protocols and M&E needs	Meet brood collection protocols and M&E needs
Barrier Guidelines	100% spring Chinook. Allow for kelt and juvenile movement up and down stream.	Sufficient to capture brood and limit hatchery adult escapement Allow for kelt and juvenile movement up and down stream.	Sufficient to capture brood and limit hatchery adult escapement Allow for kelt and juvenile movement up and down stream.
Trapping Period	Apr 21 - Oct 31	Jan 21 - May 30	Jan 21 - May 30
Barrier Period	During trapping	During trapping	During trapping
M&E Requirements	Intercept all adult spring Chinook destined for above Moving Falls.	Intercept no less than 50% of the adult winter steelhead population.	Intercept no less than 50% of the adult winter steelhead population.

4.2 Trapping Site Evaluation Process

4.2.1 Sites Considered

Initial field visits were conducted to determine which locations would be appropriate for the development of fish collection facilities. Project engineers used the following parameters to conduct the initial site assessment: stream topography, geomorphology, site conditions, access, permitting and agreements, and hydraulic conditions. Data collected from field visits was compiled into a matrix that was used to determine which sites should be eliminated, and which should proceed to the next stages of consideration. Table 19 presents the sites that were evaluated on each of the tributaries of the Hood River Basin. These locations are illustrated in Figure 10.

Table 19: Sites Evaluated for Potential Trapping Facilities

Hood River Tributary	Location
East Fork	Screw Trap/County Pit (Migrant Trap)
	Dee Mill
	EFID Sand Trap
Middle Fork	Migrant Trap
	Red Hill Drive
West Fork	Moving Falls
	Greenpoint
	Punchbowl

4.2.2 Preferred Collection Site Alternative

Following on-site evaluation of each of the locations shown in Table 19, several sites were eliminated from further consideration. Sites deemed appropriate for further consideration for barrier and trap facilities included: Screw Trap/County Pit (East Fork), Migrant Trap (Middle Fork), and Moving Falls (West Fork).

Upon further discussion, co-managers chose the Moving Falls location as a trapping site; the Middle and East fork locations were dropped, though they may be reconsidered in the future. Co-managers propose an adult trap and barrier on the Lower East Fork Hood River just below the confluence of the East and Middle forks. From a biological standpoint, a single combined trap on the Lower East Fork Hood River is optimal as such a facility could provide co-managers with the capability to capture winter steelhead (both hatchery and wild) that may spawn both in the East Fork and in the lower portions of the Middle Fork below the recently-formed falls. However, the hydraulic conditions of the mainstem downstream of the forks produce a high flow resulting from the combined flows from both forks; therefore, the installation and maintenance of a single trap on the Lower East Fork, though cost-effective, may be difficult to operate during peak events.

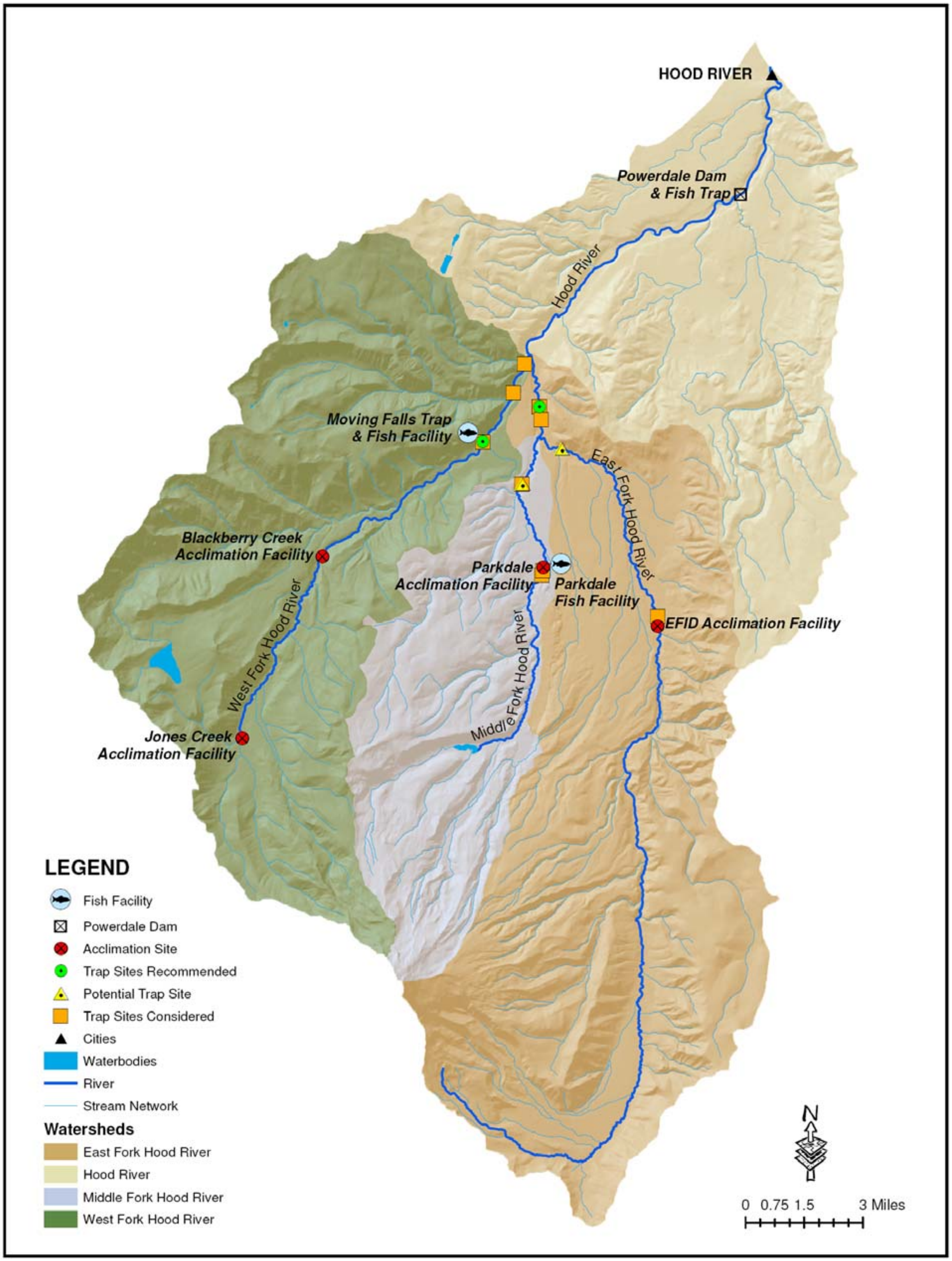

Figure 10: Potential Adult Trap Sites Evaluated

If installation and operation of a mainstem trap downstream of the Middle and East forks proves infeasible following initial operation, co-managers propose the installation of two separate traps, one on the East Fork and one on the Middle Fork. The location of a potential trap on the East Fork would be just upstream of the confluence of the Middle and East forks at approximately RM 0.5. On November 7, 2006, the Middle Fork experienced a massive flood that resulted in a significant debris flow that created natural waterfalls at about RM 1.0 of the tributary. These falls now present a fish barrier; therefore, the potential placement of a trap on the Middle Fork would be determined at a future date, when the area's geologic character and the condition of the falls can be reconsidered.

The installation of two new trapping facilities, one on the West Fork at Moving Falls and one on the Lower East Fork downstream of the Middle Fork would allow for the collection of broodstock based on the natural migration patterns of managed stocks. Spring Chinook and summer steelhead primarily use the West Fork for spawning and rearing, while winter steelhead use the East and Middle forks (as well as the mainstem). Because the run timing for summer and winter steelhead overlap, the stocks are mixed as they pass the Powerdale trapping facility in the lower mainstem river. Because of this, current broodstock collection and escapement estimates for steelhead are based on morphometric analysis to discriminate the stocks and allow for upstream passage, and management broodstock is also genetically identified by ecotype. According to Olsen (2004), summer and winter steelhead are distinguished based on fin and maxillary mark combinations, external coloration, degree of scale tightness and erosion, state of sexual maturity relative to time of year, external parasite load, color of gill filaments, and general appearance. Although stock identification based on these qualitative characteristics was validated by genetic analyses, the potential for error cannot be discounted. By trapping these fish near the mouths of the East and West forks (those to which they naturally migrate), the separation of these stocks for broodstock collection would become more apparent and may eliminate the potential ambiguity associated with morphometric analysis.

4.3 Barrier and Trap Design Alternatives

The alternatives presented below are described in greater detail in the Exclusion Barrier Alternatives and Alternate Broodstock Collection Memo located in Appendix 6A. The memo contains a description of each alternative, advantages and disadvantages, as well as some general design guidelines.

4.3.1 Alternatives Considered

Velocity and Hydraulic Barriers

Co-managers desire facilities that provide collection capabilities similar to those provided at the existing Powerdale trap. Initial concepts evaluated the use and effectiveness of velocity barriers as well as hydraulically operated bottom-hinge picket barriers. Velocity barriers are proven systems; however, the design requirements for height and flow, among other parameters, would result in significant effects to the surrounding environment. One of the greatest effects is the impoundment of water behind (upstream of) the structure. Such backwaters can significantly influence the topography upstream and affect land owners adjacent to the river. Given the impoundment of water, a fishway is required to move adults upstream and juveniles and kelts downstream. Given the need for a fishway and the potential effects associated with impoundment, the concept of installing velocity barriers proved cost-prohibitive as the cost for each site ranged from $2.2M to $2.9M.

Given the high cost and potential for environmental effects associated with velocity barrier facilities, hydraulic bottom-hinged picket barriers were reviewed. Such barriers require a concrete sill to secure the hinge of the pickets and provide connections for the hydraulic systems. While these systems also impound water upstream, the height is often several feet lower than the impoundments created by velocity barriers. Preliminary modeling at each trap location indicated that backwater heights would range from 1.5 feet to 2.0 feet. Like velocity barriers, the incorporation of a fishway would be necessary to move adults upstream and juveniles and kelts downstream. Additionally, the mechanical systems required to run the hydraulic system are complex and require maintenance due to the potential for wear associated with excessive glacial flour in the water. The overall cost of this system including the concrete sill, picket panels, hydraulic system, fishway, and trapping facility, is less than that of the velocity barrier system, ranging from approximately $1.2M to $1.6M for each site.

Low Cost Alternatives

Considering the high cost and permanence of velocity barriers and hydraulic hinge picket barriers, co-managers decided to evaluate other trapping alternatives to provide for the required broodstock collection. These alternatives involved a low cost, low tech approach. To begin this process, an alternatives analysis was performed to review methods for broodstock collection. The following broodstock trapping methods were reviewed:

- Gill netting
- Trammel netting
- Hook and line
- Picket weir attached to a fixed cable
- Picket weir using tripods
- Fish wheels, trap with guide nets

Considering the need to control fish migration into the forks of the Hood River, some of the above broodstock collection methods (i.e., netting and hook and line) did not meet the objectives of the program and were therefore not considered further. Of the remaining methods, each are options that have proven effective in other systems. Since the Hood River system is so dynamic with regard to flows, it is anticipated that each of the above systems would be inoperable under extreme high flow conditions given each system’s relative instability and reliance on human operation. This would affect winter steelhead broodstock collection as peak run timing often coincides with the high flow hydrograph.

Resistance Board Weirs

In addition to the methods presented above, another option was considered that is relatively low cost and does not result in backwatering or upstream river impounding: resistance board weirs (RBWs). These systems are installed on or adapted to existing concrete sills, new concrete sills, removable steel sills, or cable sills. They have the ability to withstand high flows by lying flat against the river surface, and under most river conditions, they remain compliant with NOAA Fisheries design criteria. RBWs provide a barrier to control upstream migration economically, as average overall costs of these systems range from $400k to $500k. RBWs have been installed in systems similar to the Hood River with success. See Appendix E for details and photos of RBWs.

4.3.2 Analysis of Costs and Effectiveness of Barriers Considered

Costs

Before comparing all types of broodstock collection in a matrix, the HRPP's operational guidelines must be considered. For the HRPP, an important component of the program is to exclude hatchery-origin fish from migrating above the trapping facilities. This alone eliminates the need for investigating costs associated with non-barrier trapping systems. In comparing barrier trapping systems, the three that were given the most consideration were velocity barriers, hydraulic bottom-hinge picket barriers, and RBWs. As discussed above, velocity barriers and hydraulic bottom-hinge picket barriers are permanent fixtures in the environment where RBWs have the flexibility to be seasonal or permanent fixtures. The cost of each system varies based on the complexity of the design and location of the system in each reach. Table 20 compares the cost of the three types of barriers and trapping systems. A detailed breakdown of costs associated with each type of barrier is presented in Appendix E.

Table 20: Capital Costs for Trapping Systems Considered

Type of Barrier and Trapping System	Capital Cost Range
Velocity Barrier	$2.2M to $2.9M
Hydraulic Bottom-Hinge Picket Barrier	$1.2M to $1.6M
Resistance Board Weir	$400k to $500k

Ability to Function in Hood River

The Hood River is a very dynamic system capable of generating flows that are inundated with glacial flour as well as cobbles, boulders, and large woody debris. Over the years, the system has seen rain on snow events that dramatically exacerbate bedload movement and transport. To determine the expected size of debris that could move in the water column during storm events, project engineers performed a particle analysis (see Appendix F). This information is useful to determine the periods during which the trapping systems may become susceptible to damage, and in some cases, destroyed. Additionally, hydraulic modeling of each site was performed on a preliminary level to predict the response of each barrier system to specific flows. Specifically, such modeling is used to determine when picket barriers are expected to exceed NOAA criteria. This modeling also predicts a structure's physical resistance, determines bedload size moving in the water column, and compares flow against migration. Appendix F contains analyses of flow and migration as well as barrier exceedance due to flow from storm events.

As a result of the aforementioned analyses, it was determined that velocity barriers are the most resistant to particle movement, because they have no moving parts. With no mechanical parts, velocity barriers can pass debris and the affects of glacial flour are minimized. However, they do collect and retain cobbles due to the head differential between the upstream and downstream sides, and the upstream side of the barrier would eventually fill with bedload causing potential problems with the inlet control of the fishway.

The hydraulic bottom-hinge picket system has the potential to collect debris if operations fail. In general, these systems are lowered to pass debris that is collected, but the suspended glacial flour would wear on the moving parts. Like the velocity barrier, it has the potential to retain cobbles on the upstream side of the barrier, but the effects of the cobble buildup at the fishway can be more easily mitigated due to the fact that the anticipated build up is a fraction of what can be expected in the velocity barrier system.

RBWs can be operated at high flows and have the ability to submerge during high flows to pass debris. If a concrete sill is installed, bedload would collect upstream. However, use of a temporary sill would reduce build up, because the sill would be removed for part of the year, allowing bedload to redistribute. RBWs do not require a fishway, as the associated trap allows for downstream passage of adult fish and capture of upstream migrants. Additionally, RBWs are sized appropriately to allow for free upstream and downstream movement of juveniles.

Alternative Rankings

Each of the three alternatives was ranked considering the cost, complexity, environmental effects, operation requirements, broodstock collection guidelines, control of adult migration in the forks, juvenile and kelt downstream passage, and ability to meet NOAA criteria for anadromous salmonids. The results of the ranking process are presented in Table 21. While each column represents criteria to compare and contrast each system, many sub-categories fell out that were also evaluated.

Table 21: Barrier Type Ranking Criteria and Results

Barrier and Trap Type	Ranking from 1 to 3 (3 being most desirable)										
	Cost	Complexity	Environmental Effects	Permanent Facility	Seasonal Facility	Operation Requirements	Broodstock Collection Guidelines	Adult Migration Control	Juvenile and Kelt Passage	NOAA Design Criteria	Totals
Velocity Barrier	1	3	1	1	0	3	3	3	3	3	21
Hydraulic Picket Barrier	2	1	2	1	0	1	3	3	3	3	19
Resistance Board Weir	3	2	3	3	3	2	3	3	3	3	28

Based on the ranking system, RBWs ranked the highest followed second by velocity barriers, and third by the hydraulic bottom-hinge picket barrier.

4.3.3 Preferred Trapping Alternative

Chosen Alternative: Resistance Board Weirs

The preferred alternative was determined to be the RBW and trap box. An RBW would meet the broodstock collection guidelines as well as program monitoring and evaluation (Table 21). The RBW footprint at each location would minimize the environmental impact in comparison with other options because the systems are not permanent fixtures, and would not result in backwatering or significant changes to the geomorphology of the reaches. RBWs provide great flexibility due to their capability to be deployed quickly and simply. Passage around the RBW can be accommodated for fish migrating upstream, as well as juveniles and kelts and other species moving downstream, including passage of watercrafts. The cost of RBWs when compared to velocity barriers and hydraulic picket barriers is less than half.

Conceptual Designs

Figure 11 illustrates the conceptual design of the RBW at the West Fork location and shows that RBWs can be quite adaptable to existing structures. On the West Fork at the Moving Falls location, the RBW would tie into the most downstream concrete grade control structure that was previously installed by ODFW to prevent undercutting and facilitate upstream passage in the vicinity of Moving Falls. The trapping facility would be located on the left bank.

Figure 12 presents the RBW concept for the trap proposed to be located on the Lower East Fork downstream of the Middle Fork. The proposed RBW would be secured by a cable sill to minimize the effect associated with constructing a concrete sill. The RBW would be outfitted with a trap box that is capable of collecting winter steelhead throughout the run.

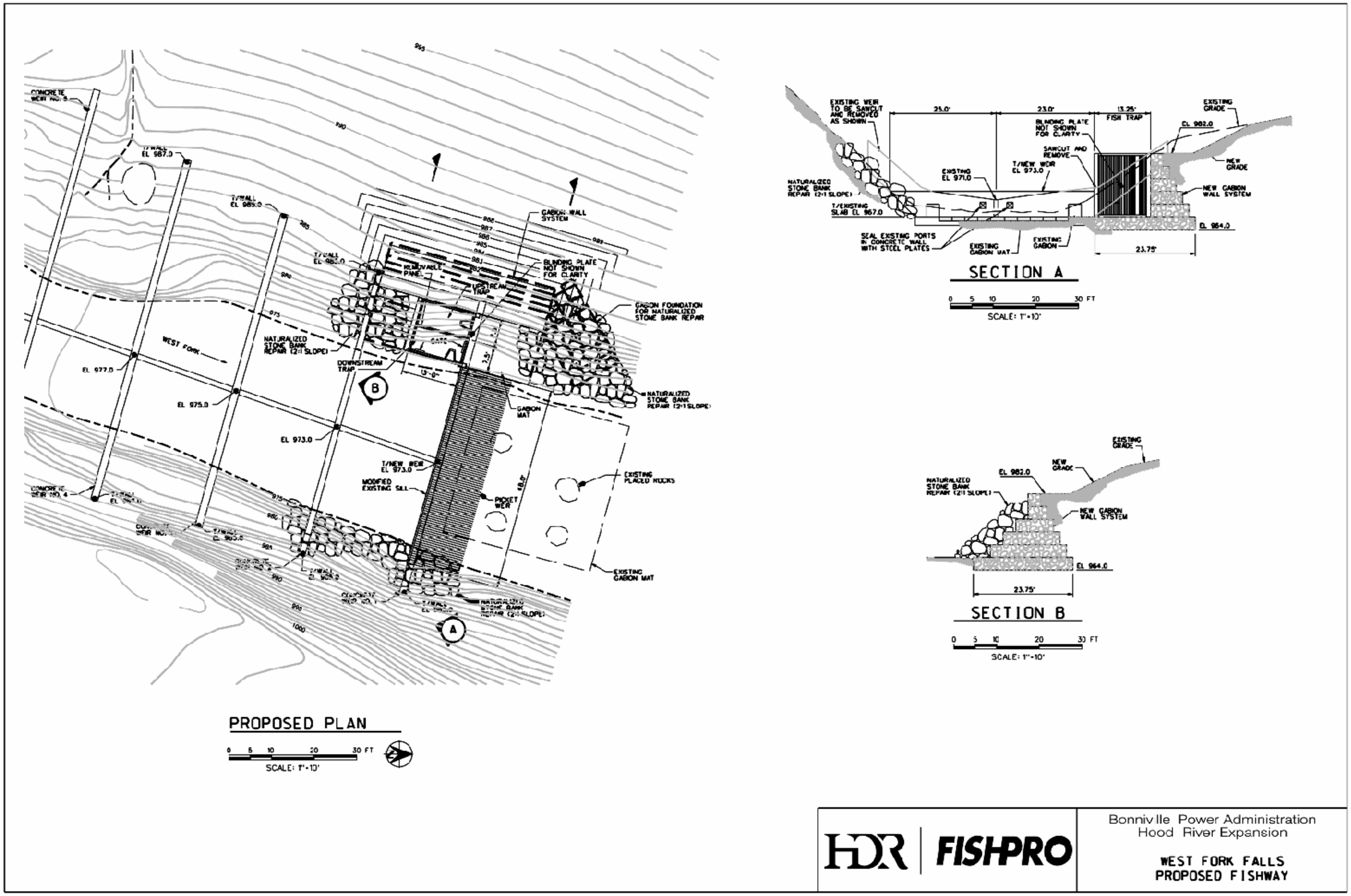

Figure 11: Typical Removable Sill RBW System with Trap Proposed at the West Fork Location

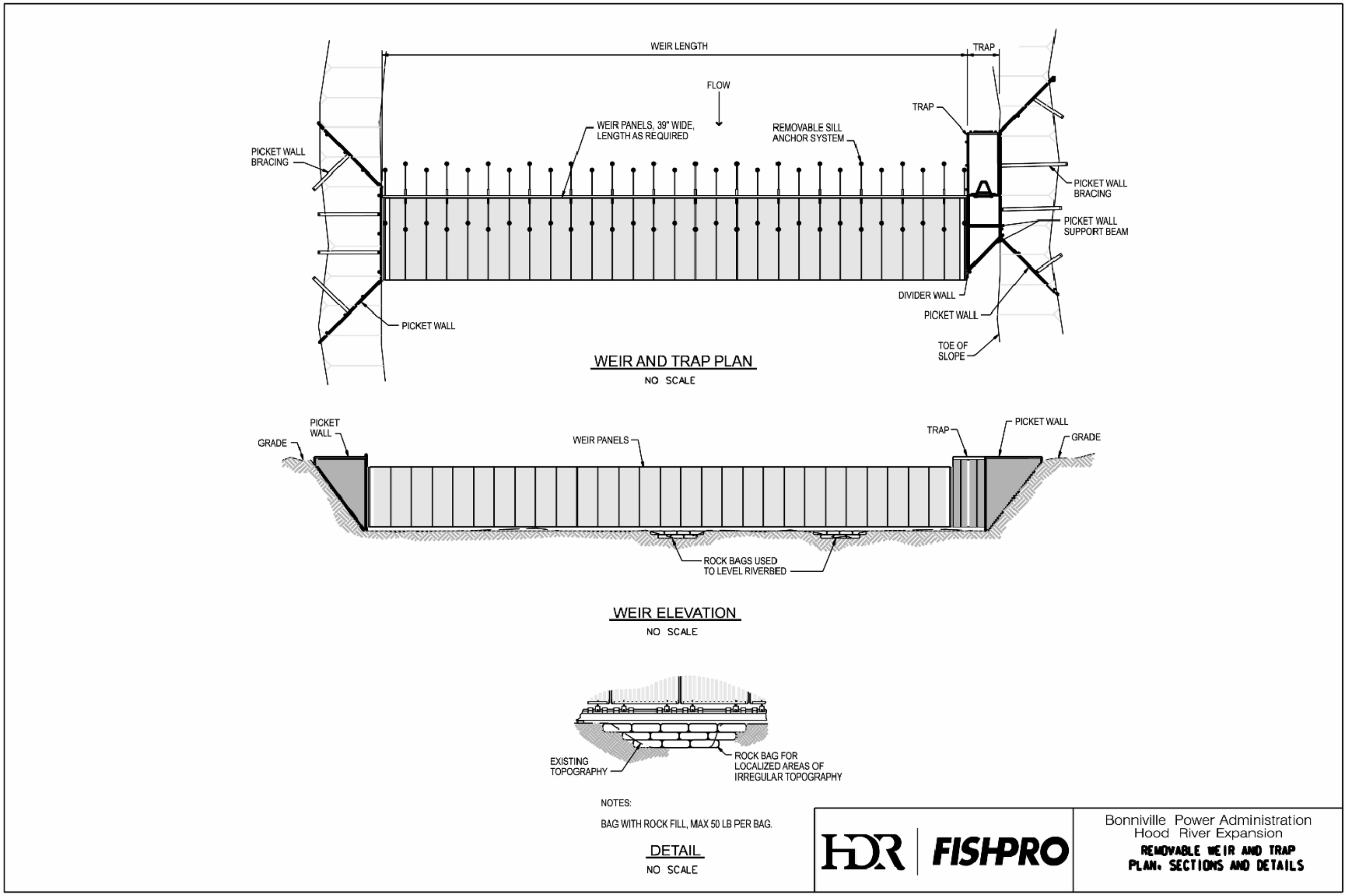

Figure 12: Typical RBW Proposed for Lower East Fork Downstream of the Middle Fork. This RBW would be installed with a cable sill to minimize permanent structures in the river.

Effectiveness of RBWs in Dynamic Hood River

High flow conditions can overrun RBWs and submerge them below the water surface, resulting in a barrier and trap failure. With respect to the proposed RBWs at the Lower East Fork and West Fork locations, anticipated trap performance was analyzed for three hydraulic conditions: daily 0.1%, 10%, and 50% exceedance flows. The exceedance flows were derived from gage data collected from 1966 to 2006. Figure 13 and Figure 14 illustrate the frequency that hydraulic conditions may cause an RBW to fall below the water surface level and/or exceed the 1ft/sec passage criteria defined by NOAA Fisheries (NMFS 2004). As might be expected, infrequent peak high flow events would render the RBWs at least partially ineffective (Table 22).

In the West Fork, the barrier has been designed to fall below water surface at 1ft/sec to ensure the trap meets NOAA criteria. This is achieved by diverting water through the trap with control structures such as stop logs. As a result, the proposed West Fork trap would be 100% NOAA Fisheries compliant in relatively high (10% exceedance) and average flows (50% exceedance), and 98% compliant during infrequent peak conditions (0.1% exceedance). The RBW in the West Fork would act as a 100% barrier in high (10%) and average (50%) flows, and 96% barrier during infrequent peak (0.1%) conditions.

As designed, the proposed RBW in the Lower East Fork (downstream of the Middle Fork) would be 100% NOAA compliant during average flow conditions, 98% compliant during high(10%) and 65% compliant during infrequent peak flow (0.1%). The RBW would serve as a barrier during average and high flows. The barrier would be a barrier during 98% of the peak flow conditions. Thus during 2% of the peak flow conditions, the barrier would fall below the surface and allow some fish to pass the trap undetected. During these periods of extremely high flow it is anticipated that the trap would continue to act as a barrier for the following reasons. The barrier is weakest in mid channel where the water velocity is the greatest. As a result the trap will tend to fall under the water surface in the center of the trap. Fish would likely migrate upstream near the banks where the stream flow is slowest, allowing the non-submerged portions of the RBW to continue to act as a barrier. Therefore, during extreme high flow events the RBW would not be defined as a true barrier, but would still effectively act as a barrier when considering fish behavior.

Table 22: Resistance Board Weir Capacity to Meet NOAA Compliance and Program Guidelines at West Fork and Lower East Fork Downstream of the Middle Fork Locations

		NOAA Compliance			Barrier Operational		
Exceedance Flow		**0.1%**	**10%**	**50%**	**0.1%**	**10%**	**50%**
West Fork	# of Days	190	194	194	187	194	194
	Days in Service	194	194	194	194	194	194
	% of Service Days	98%	100%	100%	96%	100%	100%
Lower East Fork (includes Middle & East)	# of Days	85	128	131	129	131	131
	Days in Service	131	131	131	131	131	131
	% of Service Days	65%	98%	100%	98%	100%	100%
Other Potential Sites							
Middle Fork	# of Days	45	118	131	126	131	131
	Days in Service	131	131	131	131	131	131
	% of Service Days	34%	90%	100%	96%	100%	100%
East Fork	# of Days	0	1	131	78	127	131
	Days in Service	131	131	131	131	131	131
	% of Service Days	0%	1%	100%	60%	97%	100%

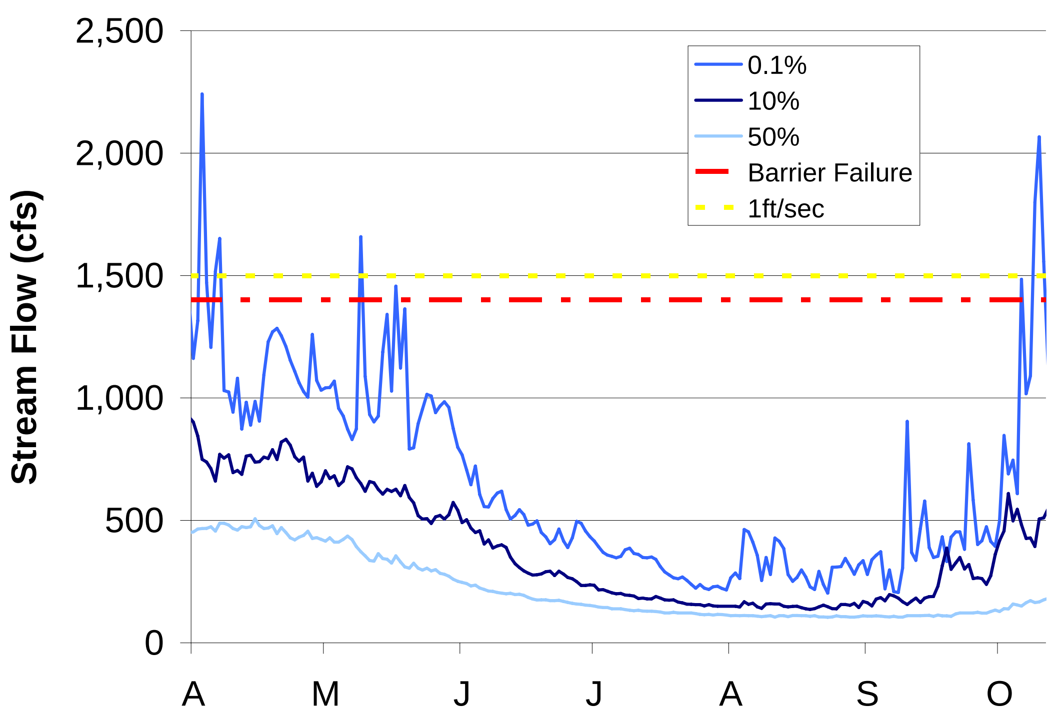

Figure 13: West Fork Hood River at Moving Falls Exceedance Flows Based on 70% of Dee Stream Flow Gage

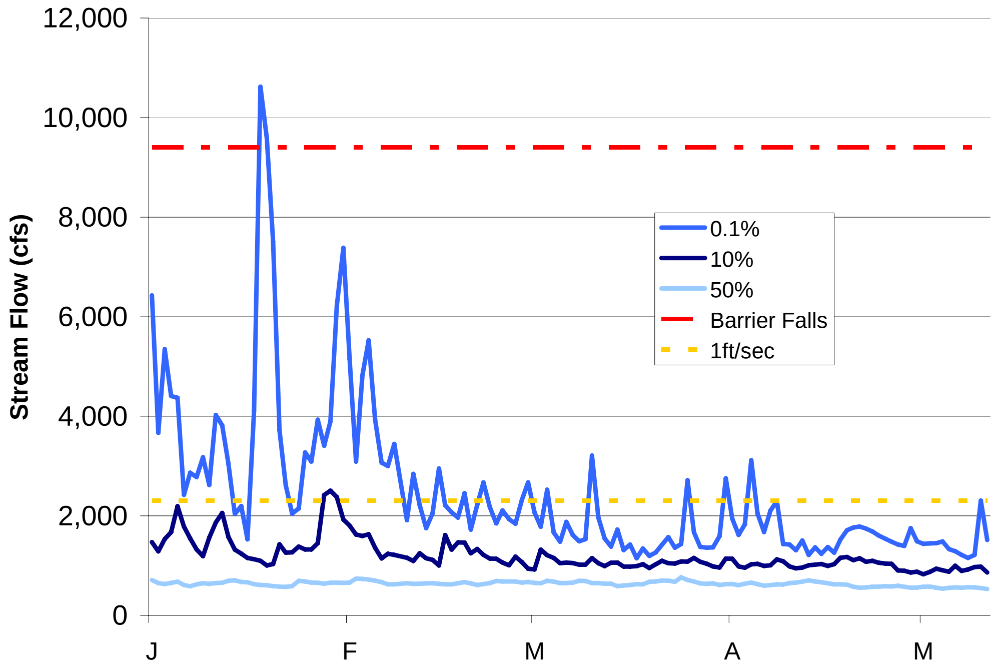

Figure 14: Hood River at Moving Falls Exceedance Flows Based on 70% of Dee Stream Flow Gage Preferred Alternative Performance with Regard to Collection Goals

The proposed RBWs for the West Fork and Lower East Fork locations would be constructed and operated to meet broodstock collection guidelines and M&E performance criteria. For example, the West Fork trap would need to intercept all of the adult spring Chinook to meet broodstock needs (200 spring Chinook; Table 18). The Lower East Fork RBW would need to collect a sufficient number of winter steelhead to meet broodstock needs (64 adults) and M&E performance criteria (greater than 50% of return). The number of returning adults was estimated based on adult fish collected at Powerdale and the program's biological fish objectives (Olsen 2007). Based on the average daily return and whether the barrier would be 100% operational or submerged due to high flow events, the anticipated number of returning adults captured at each of the proposed RBWs was estimated (Table 23). During average hydraulic conditions (50% exceedance flows) in the West Fork, all spring Chinook are anticipated to be collected.

In the lower East Fork, the proposed RBW is estimated to collect between 97% and 99% of the returning winter steelhead based on average to infrequent peak flow events. Both the RBWs are expected to meet or exceed program performance criteria.

Table 23: Estimated Percent and Number of Adults Interrogated at Proposed West Fork and Lower East Fork Traps based on Average Historic Returns.

	Trap Location	Exceedance Flow	Winter Steelhead		Spring Chinook	
			Wild	Hatch	Wild	Hatch
Percent Intercepted At Trap	West Fork At Moving Falls	0.10%	0%	0%	93%	97%
		10%	0%	0%	100%	100%
		50%	0%	0%	100%	100%
	Middle Fork At Mouth	0.10%	97%	94%	18%	49%
		10%	99%	97%	18%	49%
		50%	99%	97%	18%	49%
	East Fork Above Middle Fork	0.10%	81%	71%	0%	0%
		10%	98%	95%	0%	0%
		50%	99%	97%	0%	0%
	Lower East Fork Below Middle Fork	0.10%	99%	96%	18%	49%
		10%	99%	97%	18%	49%
		50%	99%	97%	18%	49%
Number Intercepted At Trap	West Fork At Moving Falls	0.10%	0	0	40	196
		10%	0	0	43	202
		50%	0	0	43	202
		Total Possible	0	0	43	202
	Middle Fork At Mouth	0.10%	234	207	3	42
		10%	237	214	3	42
		50%	237	214	3	42
		Total Possible	240	221	18	86
	East Fork Above Middle Fork	0.10%	292	235	0	0
		10%	353	314	0	0
		50%	355	321	0	0
		Total Possible	360	331	0	0
	Lower East Fork Below Middle Fork	0.10%	591	528	3	42
		10%	592	535	3	42
		50%	592	535	3	42
		Total Possible	600	552	18	86

CHAPTER 5: HOOD RIVER HABITAT IMPROVEMENTS

5.1 West Fork Hood River UCM and EDT Modeling and Proposed Habitat Treatments

Two modeling exercises have been used to determine the factors limiting salmonid production within the Hood River Subbasin. In 2003, S. P. Cramer and Associates employed the Unit Characteristic Method (UCM) to develop carrying capacities for spring Chinook salmon and steelhead as part of a review of the Hood River Production Program (HRPP). In 2004, through the process of developing a subbasin plan for the Hood River, the Ecosystem Diagnostic and Treatment model (EDT) was employed to determine the factors limiting production as well as the effect of various habitat treatments on production.

Key findings from the UCM modeling showed that a lack of pool habitat, combined with low wood complexity, high fines, and high turbidity were key factors limiting freshwater capacity and survival within the Hood River Subbasin. Flow enhancement was also found to increase capacity significantly. UCM modeling showed that if flows were increased an additional 10 cfs at each of the major irrigation diversions (EFID, Dee, and FID) as well as the return of 250 cfs at Powerdale Dam after decommissioning, steelhead parr capacity would increase by 10,000-20,000 and spring Chinook capacity would increase by 7,500-12,500 parr, although the authors admit that the methodology for obtaining these estimates are somewhat dubious (Underwood et al. 2003). Significant progress has been made to date with regard to restoring flows. For example, Powerdale Dam no longer diverts water, 2.0 cfs is proposed to be returned to the East Fork due to ditch piping, and plans are in progress to decommission the Dee irrigation intake. Though decommissioning of the Dee intake is not likely to increase flow, it may provide better passage.

Key findings from EDT showed that the five primary limiting factors in the subbasin were channel stability, habitat diversity, flow, sediment load, and key habitat quantity (Coccolli 2004).

5.1.1 West Fork Hood River

According to UCM modeling, a key factor influencing the carrying capacity of the West Fork Hood River was the percentage of pools. Pools were considered capable of supporting the highest density of Chinook parr (24.0 fish/100m^2), followed by glides (7.0 fish /100m m^2), rapids (2.4 fish /100m m^2) and riffles (2.4 fish /100m^2). Average wood scores throughout surveyed habitat were low. Wood complexity was rated on a scale of 1 to 5 with 1 being no wood present, and 5 being accumulations of small and large pieces of wood providing complex cover at all flow levels. Average ratings in pools of surveyed reaches were 1 to 1.4 (Underwood et al. 2003). Steelhead capacity in the West Fork was limited due to lack of pool habitat, cover, alkalinity and turbidity (Underwood et al. 2003).

EDT results for the West Fork Hood River found that the primary limiting factors were channel stability, habitat diversity, flows, sediment load, and key habitat quantity. EDT modeled the restoration of large wood levels in and along streams to levels approximating the template condition which was established at 1800 or the pre-settlement period. For the most part only depositional reaches where wood normally would have accumulated were modeled although a few other reaches with steeper gradients were included based on local professional experience (p.86, Coccolli 2004). These included all reaches above Moving Falls with the exception of EDT reach 10 at RM 9.

The EDT model predicted the largest significant gains to habitat diversity and key habitat quantity would come from restoring LWD to the Hood River Subbasin (Coccolli 2004). With the addition of LWD, the model predicted a corresponding increase in population numbers, especially for spring Chinook. Large wood should improve several conditions related to habitat diversity and key habitat quantity, both limiting factors that affected all focal species and most life stages (Coccolli 2004). Increasing instream and riparian LWD could result in an increase in fry to smolt survival for spring Chinook by increasing riparian-floodplain interactions and increasing the amount of key habitat including shallow backwaters and slow-velocity margin habitats (Coccolli 2004). Channel stability affected all life stages of focal species from egg through juvenile rearing. Channel stability is tied primarily to the bed scour attribute – the more bed scour the larger the effect on the various life stages for each focal species. The most deleterious effect appeared to be during the egg incubation stage with moderate effects on fry colonization and inactive rearing (i.e. overwintering) stages.

High levels of bed scour are not surprising given the glacial nature of the major tributaries where most spawning occurs, a flashy hydrograph, and frequent rain on snow events. Historically, LWD is believed to have moderated the effects of small to medium sized peak flows. Historic levels of large wood created backwater and other lateral flood refuge areas, as well as promoted gravel retention and stability in smaller events. With LWD restoration to the template condition, the EDT model predicted increases in smolt abundance from 39% to 58% for summer and winter steelhead and from 62% to 375% for spring Chinook (Coccolli 2004).

5.1.2 LWD Treatments

Supported by the findings of the UCM and EDT models, the HRPP proposes to increase the amount of in-channel and floodplain LWD at six locations on the West Fork Hood River, including Lake Branch, Elk and McGee Creeks, which are tributaries to the West Fork (see Figure 15). These six projects will treat an estimated 9 miles of stream and 110 acres of habitat, and will be conducted in partnership with the U.S. Forest Service. The following sections describe details of each project. All applicable state, local, and federal permits will be obtained prior to implementation of any LWD project. These projects are proposed over a ten-year period. Funding has not yet been secured, but will be sought through a combination of BPA, USFS, NOAA, and Oregon Watershed Enhancement Board (OWEB) sources.

It should be noted that during the 2006-2007 season, 328 logs were added to the West Fork between Ladd and McGee Creeks (RM 13.1-14.0).

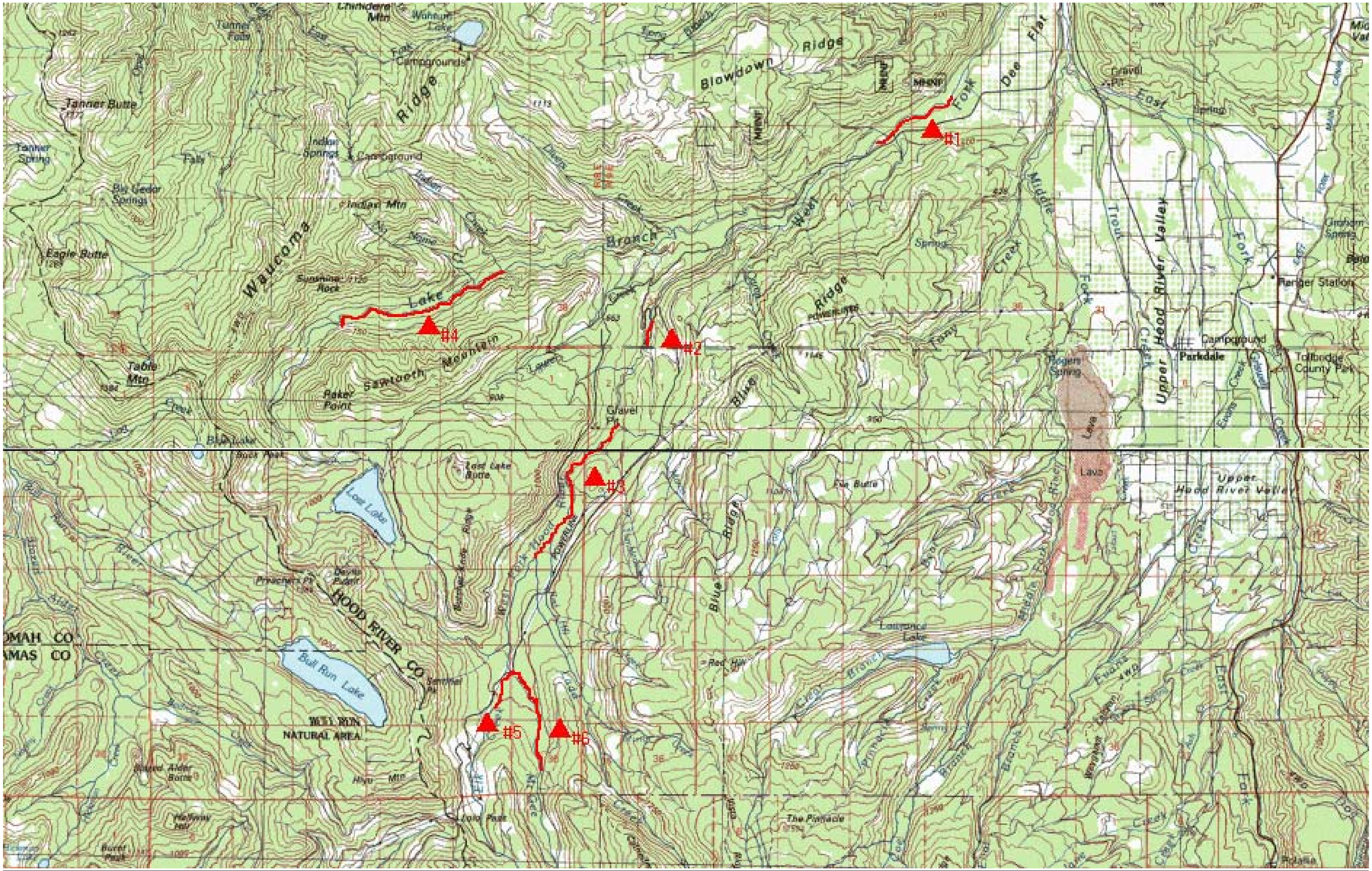

Figure 15: Six Locations Proposed for LWD Enhancement on the West Fork Hood River

West Fork Hood River LWD Addition

This project will occur between approximate RM 2.7 and 4.2. The objective is to maintain and improve spawning and rearing habitat for Chinook salmon and steelhead trout in this low gradient section of the West Fork Hood River. This project will implement strategies designed to:

- Increase the amount of in-channel LWD to 150-200 pieces per mile;
- Increase the amount of floodplain LWD to 30 pieces per acre;
- Collect, sort, and store suitable sized spawning gravel for Chinook salmon and steelhead trout; and
- Maintain or improve the connection between the stream channel and floodplain.

To achieve these objectives, approximately 600 logs/whole trees will be added to 27 acres of floodplain. An additional 200-350 logs/whole trees will be added to the stream channel in the West Fork Hood River between Moving Falls and approximately ½ mile downstream from the West Fork Bridge.

This project reach will be divided into four distinct sections, beginning with the most upstream location: Section 1 is located from RM 4.2 to 4.0; Section 2 is from RM 4.0 to 3.7; Section 3 is from RM 3.7 to 2.9; and Section 4 is from RM 2.9 to2.7 (note these river miles are approximate based on GIS). Sections 1 and 3 will be discussed together as they are very similar in configuration; likewise Sections 2 and 4 are similar enough they will be discussed together. In all sections the log placement will be designed to maintain the existing channel gradient, reduce bank and floodplain erosion during high flows, and collect and sort spawning sized gravel. In the floodplain, the wood will be placed in overflow channels and other topographic low spots to provide roughness during over bank flow events.

Sections 1 and 3

These two river reaches are characterized by moderate gradient (3-4%), substrate ranging from large cobble to large boulder, and very little pool or spawning habitat (riffle dominated). There is virtually no LWD in either reach. Floodplains are from 1-4 feet above the low flow channel and they vary in width from 30-100 feet depending on the site. In-channel wood will be placed along the margins of the main channel in locations where a floodplain is present on one or both sides. The objective is to promote more frequent floodplain inundation as well as to create scour and gravel deposition. No channel spanning logjams will be constructed although in some areas the margin LWD could protrude into the channel up to 1/3 of the bankfull width. Approximately 25% of the total LWD needed for this project would be used in these reaches.

Sections 2 and 4

These two river sections are lower in gradient (2%) with generally smaller substrate ranging from gravel to small boulder. The river has more room to move around and indeed both sites have more accessible floodplains and side channels that are watered at least part of the year. Floodplains range from 1-3 feet above the low flow channel and floodplain widths approach 200 feet in some areas.

Wood placement in these sections will focus on topographic low points in the active floodplains, margin wood placement on the outside of bends, and full or partial channel spanning logjams designed to maintain the existing channel gradient and/or maintain channel sinuosity. The logjams will require large amounts of LWD – 50 or more pieces at each site – to ensure they are stable and remain in place. One logjam is proposed in Section 2, and two logjams are proposed in Section 4. The logjam in Section 2 will span the side channel located on the left (looking downstream bank). In Section 4 one logjam will span a side channel on the right side of the river and the other will extend about half way across the main channel.

West Fork Hood River – Dry Run Bridge LWD

This project will occur between approximate RM 8.2 and 8.6. The objective is to maintain and improve spawning and rearing habitat for Chinook salmon and steelhead trout in this low gradient section of the West Fork Hood River. This project will implement strategies designed to:

- Increase the amount of in-channel LWD to 150-200 pieces per mile;
- Increase the amount of floodplain LWD to 30 pieces per acre;
- Collect, sort, and store suitable sized spawning gravel for Chinook salmon and steelhead trout; and
- Maintain or improve the connection between the stream channel and floodplain.

These objectives will be realized with the placement of approximately 180 logs/whole trees added to 6 acres of floodplain and an additional 200-350 logs/whole trees added to the stream channel in the West Fork Hood River just upstream from Dry Run Bridge.

Log and boulder placement will be designed to maintain the existing channel gradient, reduce bank and floodplain erosion during high flows, and collect and sort spawning-sized gravel. On the floodplain, the wood will be placed in overflow channels and other topographic low spots to provide roughness during over-bank flow events. In-channel wood will be along the margins of the main channel and a side channel. No channel spanning logjams will be constructed although in some areas the margin LWD could protrude into the channel up to 1/3 of the bankfull width.

Given the proximity to Dry Run Bridge, much of the in-channel wood, and some of the floodplain wood, will likely be anchored in some fashion. Anchoring will be a combination of digging a portion of log pieces into the streambank and/or cabling to other logs and/or boulders. The amount of anchoring will depend on the size of the wood used and the final design, which will incorporate better information regarding expected stream flows and associated water velocities.

West Fork Hood River LWD Addition, Marco Creek to mapped Ladd Creek

This project will occur between approximate RM 10.1 and 13.1. The objective is to maintain and improve spawning and rearing habitat for Chinook salmon and steelhead trout in the low gradient sections of this reach of the West Fork Hood River. This project will implement strategies designed to:

- Increase the amount of in-channel LWD to 150-200 pieces per mile;
- Collect, sort, and store suitable sized spawning gravel for Chinook salmon and steelhead trout; and
- Maintain or improve the connection between the stream channel and floodplain.

These objectives will be realized with the placement of approximately 5-10 large log jams (30-50 logs each) added to the stream channel and associated floodplain in the West Fork Hood River from the reach beginning at the Marco Creek confluence extending upstream to the *mapped* Ladd Creek confluence (Ladd actually enters the West Fork upstream from this point). The jams would be located at low-gradient areas on bends in the stream, and some of the structures would be channel-spanning. Log placement will be designed to maintain or improve the connections between the channel and floodplain, reduce bank erosion during high flows, and collect and sort spawning-sized gravel. A helicopter would place the wood during the ODFW in-water work window (July 15-August 15).

Lake Branch LWD Addition

This project will occur between approximate RM 4.9 and 7.2. The objective is to maintain and improve spawning and rearing habitat for steelhead trout in this section of Lake Branch. This project will implement strategies designed to:

- Increase the amount of in-channel LWD to 150-200 pieces per mile;
- Increase the amount of floodplain LWD to 30 pieces per acre;
- Collect, sort, and store suitable sized spawning gravel for steelhead trout; and
- Maintain or improve the connection between the stream channel and floodplain.

Portions of this reach have been the focus of past restoration efforts to increase the amount of LWD in the channel. This project would focus instream wood placement in stream sections between and downstream of areas already treated, especially the lower 1.5 miles, as well as the floodplain through the entire reach (which was not the focus of past treatment). There would be approximately 20 logjams placed in Lake Branch, with additional LWD placed along the stream margin and in the floodplain. In all, the project would use approximately 1500 pieces of LWD and would extend from the Indian Creek confluence upstream to Raker Pit, a distance of approximately 2.3 RM.

Elk Creek LWD Addition

This project will occur within the first .5 miles of Elk Creek. The objective is to maintain and improve spawning and rearing habitat for Chinook salmon, steelhead trout and resident rainbow trout in this section of Elk Creek. This project will implement strategies designed to:

- Increase the amount of in-channel large woody debris (LWD) to 150-200 pieces per mile;
- Increase the amount of floodplain LWD to 20 pieces per acre;
- Collect, sort, and store suitable sized spawning gravel for Chinook salmon and steelhead trout;
- Maintain or improve connection between stream channel and floodplain; and

- Move the lower 0.2 miles of channel back into the shaded riparian corridor, away from a BPA powerline. The existing channel will function as a side channel during high flow events.

Approximately 10 channel-spanning logjams would be placed in Elk Creek on Longview Fibre land (approximately RM 0.0 to 0.5), along with smaller log clusters along channel margins. In addition, logs would be placed in the floodplain along this same stream reach. Log placement will be designed to aggrade the channel where incised, maintain or create pool habitat, reduce bank erosion during high flows, and collect and sort spawning sized gravel. The lower 0.2 miles of the channel are currently flowing directly under a BPA powerline (the channel migrated out from under the narrow, shaded riparian buffer). The creek will be re-routed back into the riparian corridor where there is more vegetation, leaving the existing channel to act as a side channel during high flows. This re-route will be accomplished by placing a large log jam at the avulsion point to direct flow into the old channel. Both channels will be treated with LWD.

McGee Creek LWD Addition

This project will occur within the first 1.8 miles of McGee Creek. The objective is to maintain and improve spawning and rearing habitat for Chinook salmon, steelhead trout, and resident rainbow trout in this section of McGee Creek. Also, there is a need to improve upstream passage for juveniles by altering high logs sills that are potential barriers. This project will implement strategies designed to:

- Increase the amount of in-channel large woody debris (LWD) to 150-200 pieces per mile;
- Increase the amount of floodplain LWD to 30 pieces per acre;
- Collect, sort, and store suitable sized spawning gravel for Chinook salmon and steelhead trout; and
- Maintain or improve the connection between stream channel and floodplain.

Approximately 10-15 channel-spanning logjams with smaller log clusters would be added to the margin of McGee Creek on Longview Fibre land (approximately RM 0.0 to 1.3). Wood would also be added to the adjacent 16 acres of floodplain. The floodplain varies from 35’ - 75’ wide on either side of the stream. On Forest Service land immediately upstream, some high log sills that were placed in the 1980s to early 1990s would be altered to provide for juvenile salmonid passage (approximately RM 1.3 - 1.8).

Wood placement will be designed to reconnect the channel and floodplain in the Longview section of land by promoting channel aggradation, reducing bank and floodplain erosion during high flows, and collecting and sorting spawning-sized gravel. On the floodplain, the wood will be placed in overflow channels and other topographic low spots to provide roughness during over bank flow events.

CHAPTER 6: HOOD RIVER PRODUCTION PROGRAM MONITORING AND EVALUATION

6.1 Spring Chinook Salmon Comparative Release Evaluation Study Design

HRPP co-managers are proposing a comparative hatchery release evaluation study that compares the size at release, precocial maturation, straying, disease burden, and smolt-to-adult return survival (SARs) of spring Chinook released in the Hood River Basin that are reared at Carson National Fish Hatchery in the Wind River drainage (WA), Round Butte Hatchery / Pelton Ladder in the Deschutes Basin (OR), and a test group of juveniles reared at the Parkdale Fish Facility (PFF) in the Hood River Basin. The results will provide the necessary information for co-managers to determine a long term biologically sound and cost effective spring Chinook salmon production strategy for the Hood River Basin that balances harvest needs with ecological considerations.

The objective of this evaluation is to provide managers with the information necessary to determine the most cost effective approach (or combination of approaches) for: 1) rearing HRPP spring Chinook salmon smolts to an average size of 15-18 fish per pound at release; and 2) increasing the average adult SAR to 0.4% while maintaining a minimum SAR above 0.18%

Hypothesis 1: There are no significant differences in smolt size between groups of fish reared in Pelton Ladder, Carson Hatchery, and PFF that are released in the West Fork Hood River.

Alternative1: There is a significant difference in smolt size between groups of fish reared in Pelton Ladder, Carson Hatchery, and PFF that are released in the West Fork Hood River.

Hypothesis 2: Rate of precocial maturation are similar among Carson Hatchery, Pelton Ladder, and PFF release groups that are released in the West Fork Hood River.

Alternative 2: Rate of precocial maturation are not similar among Carson Hatchery, Pelton Ladder, and PFF release groups that are released in the West Fork Hood River.

Hypothesis 3: There is no significant difference in SARs from smolts released at Moving falls to adult returns to the Moving fall weir among groups of fish reared in Pelton Ladder, Carson Hatchery, and PFF.

Alternative 3: There are significant differences in SARs from smolts released at Moving falls to adult returns to the Moving fall weir among groups of fish reared in Pelton Ladder, Carson Hatchery, and PFF that are released in the West Fork Hood River.

6.1.1 Methods

Table 24: Proposed HRPP spring Chinook salmon BY 2008 release strategy in 2010

Facility	# Reared	Life Stage Delivered To Acclimation Site	Type of Release
Round Butte Hatchery / Pelton Ladder	75,000	Pre-smolt	March-April Acclimation –Forced Release
Carson National Fish Hatchery	45,000	Pre-smolt	March-April Acclimation –Forced Release
Parkdale Fish Facility	30,000	Pre-smolt	March-April Acclimation –Forced Release

Brood Collection, Spawning and Incubation

Brood collection for the study will begin during 2008. Approximately 200 adult spring Chinook broodstock would be collected annually at Powerdale Dam (river mile 4.0) by HRPP personnel during brood years 2008-2010. For brood years 2011-2013, fish would be collected from the West Fork Hood River at Moving Falls. Brood will be randomly collected in proportion to run timing from mid-April through late August with a target of 100 females and 100 males. Ten percent of the male brood will consist of jacks. If sufficient natural-origin adults are predicted to escape to the Hood River, managers would try to incorporate sufficient NOR brood to comprise 10% of the total brood.

Broodstock will be transferred to adult holding ponds at the Parkdale Fish Facility. Adults will be routinely injected with erythromycin 200 @ 5mg/lb. to control BKD and oxytetracycline hydrochloride at 5mg/lb. to control furunculosis. Brood collected before July will receive injections at date of collection and again in the middle of July. Any brood collected after July 1st will only receive one set of injections.

Additionally, brood will be treated with a formalin or hydrogen peroxide bath 3 times per week to control fungus and reduce pre spawning mortality. Spawning will be coordinated with fish health personnel to ensure ovarian and milt samples are taken from each adult and checked for the presence of viral or bacterial diseases.

The broodstock will be spawned as they become ripe. Spawning generally begins in late August and continues through September. One male will be spawned with one female. After the eggs are fertilized they will be rinsed in pathogen free Rogers Creek water. The fertilized eggs will be placed in vertical stack incubators that are filled with a 100 ppm iodophore (polyvinylpyrrolidone iodine) solution. The eggs will be water hardened in iodophore for 15 minutes to mitigate the disease threat of vertically transmitted pathogens. After shocking the eggs are sorted and inventoried. Eyed eggs will be delivered to each facility for final incubation and rearing beginning during November 2008.

Table 25: Approximate Number of Eggs Delivered to Each Facility from Parkdale Fish Facility (36,000 eggs would remain at PFF to be reared onsite to produce 30,000 pre-smolts)

	Eggs Received	Target Pre-Smolt Production
Round Butte Hatchery	90,000	75,000
Carson National Hatchery	54,000	45,000

Rearing

For this evaluation, the target smolt size would be 15-18 fish per pound when delivered to Moving Falls acclimation site.

Rearing protocols at the Round Butte and Carson Hatcheries would follow standard rearing procedures and densities for those facilities. For specific protocols, refer to the HGMP for each facility.

Approximately 90,000 eggs would be delivered to Round Butte hatchery. The eggs would be incubated and the fry ponded. Juveniles would be transferred to a Pelton Ladder cell for final rearing during November, 2009, until they are delivered to the Moving Falls acclimation site during early March, 2010.

Approximately 54,000 eggs would be delivered to the USFWS operated Carson Hatchery. Smolts would be delivered to the Moving Falls acclimation site during early March, 2010.

Approximately 36,000 eggs would be retained at the Parkdale Fish Facility. The fish would be raised to pre-smolt with a target release size of approximately 15-18 fpp. They would be delivered to the Moving Falls acclimation site during March, 2010. Since significant numbers of spring Chinook have not been raised at PFF to date, the rearing of this group would be considered a feasibility evaluation.

Marking

All fish would be marked with an adipose clip, a secondary fin clip, and a CWT. Up to 10% of each release group would be implanted with PIT tags. Table 26 displays the proposed marking for each group. Alternate fin marks would be reversed each year of the evaluation (BY 2009-2010).

Table 26: Proposed BY 2008 Marking Strategy

	Ad. Clip	Secondary Fin Clip
Pelton Ladder	Yes	RM
Carson NFH	Yes	LM
Parkdale Fish Facility	Yes	LV

Fin marking and coded wire tagging would be conducted at each rearing facility. PIT tags would be applied after the fish are received at the Moving Falls acclimation facility.

Acclimation / Release:

The final design of the Moving Falls acclimation site to accommodate the needs of this study is under development. Each hatchery group should be held separately in three ponds to facilitate bi-weekly sampling fish from each group during acclimation immediately prior to release. While the holding ponds themselves would be temporary, a gravity flow water delivery system would be installed during the summer, 2009. A 4 cfs water intake would be designed to minimize the potential for icing, debris clogging, and fish entry.

Pre-smolts from Pelton Ladder, Carson Hatchery, and PFF would be delivered to the acclimation facility during early March, 2010. Fish would not exceed a density index of 0.16 in each pond.

While in the ponds, site caretakers would perform daily scheduled fish culture duties that include: checking the water intake and screens; recording oxygen, temperature and water levels in the rearing ponds three times each day; feeding the fish; and picking fish mortalities. Staff would observe fish behavior for abnormalities and assist in fish health checks, bi-weekly sampling, and PIT tagging. Feeding protocols and food type are to be determined but would be consistent among release groups.

The strategy would be to release all fish into the West Fork Hood River by the end of April. If a high water event occurs during April the fish would be forcibly released to coincide with the freshet. If no such event occurs the fish would be force released at month's end.

Adult Return Monitoring

Adult returns to the West Fork at the Moving Falls weir would be determined by CWT and PIT tag recaptures. Estimates of returning adults by release group would be made at Bonneville Dam, CWT recaptures during ocean and in-river fisheries, at the Moving Falls trap, and on the spawning grounds.

Date Analysis

The performance metrics measured would include: 1) size at release; 2) proportions of age 3 jacks and yearling mini-jack returns; and 3) smolt-to-adult survival (SAR) for release groups.

Smolt Size at Release

Our methodology will include estimating the mean length from each release group of spring Chinook salmon from the 2008 brood that are within ± 2 mm of the true mean, 95% of the time. This would be accomplished by measuring 0.1% of each release group for a total of 150 individuals. The methods to determine the sample size required to meet the precision criteria (95% C.I. = ± 2 mm) are described in Cochran (1977). Length sampling would occur when smolts are delivered to the Moving Falls acclimation site and immediately prior to release. Estimates of mean length and its variance would be calculated with standard normal procedures.

Investigators would use repeated measures or multivariate analysis of variance to determine if significant differences in size at release exist at the 95% confidence interval (CI). Data to be investigated would include water temperatures, rearing densities, and feed conversion rates at each facility.

Additionally, specific growth rates and condition factor would be determined monthly at each rearing facility and bi-weekly during acclimation. Both batch weights (fish per pound) and individual lengths and weights from 0.1% of the fish within the release group would be recorded monthly. Monthly specific growth rates would be estimated by:

$$SGR = 100 * \{\ln(\text{weight } 2) - \ln(\text{weight } 1)\} / \text{days} \tag{1}$$

where 'weight 2' and 'weight 1' are average fish weights at the end and beginning of a growth period, respectively and 'days' the duration of the growth period (Ricker 1979).

Condition factor would be calculated as:

$$CF = w/l^3 \times 100, \tag{2}$$

where w = weight in g and l = total length in cm.

Rates of Precocious Maturation (Jacks and Mini-Jacks)

The proportion of each release group that returns as yearling mini-jacks would be determined by pre-release visual examination. Each release group would be sampled for elevated plasma levels of hormone 11 ketotestosterone (11-KT) and the presence of bacterial kidney disease (BKD). Age 3 jack returns would be determined through CWT recaptures.

Immediately prior to the post-acclimation forced release in April, 2010, a sample of 60-120 smolts per release group would be sacrificed and visually examined for gender and state of gonadal development according to Larsen et al. (2004). Immature female fish are identifiable by the gonad having an anterior thickening and granular appearance. The gonads of immature male fish have a thin, clear, thread-like appearance with a diameter less than approximately 0.5 mm throughout the entire length. Precociously maturing males have gonads that are opaque with an anterior thickening of greater than approximately 1.0-1.5 mm and a smooth surface texture.

To verify the accuracy of the visual examination of the gonads, blood would be collected from each sacrificed fish and sampled for the hormone 11-KT using methods developed by Cuisset et al. (1994). Plasma 11-KT levels above 0.8 ng/ml have been observed in the testes of precociously maturing males prior to spring out-migration (Shearer et al. 2002)

After examination, the carcasses would be sent to a fish health laboratory to be examined for the presence of BKD. The bacterial protein that induces disease onset can be measured by the enzyme-linked immunosorbent assay (ELISA), the method most often used for detecting and measuring severity of BKD in fish populations. This assay would be used to measure the level and severity of BKD in fish at the time of release and at return. Levels of BKD would be correlated to the facility rearing treatment, gonadal development (precocity), and the numbers of returning mini-jacks (two year old fish) and jacks (three year old fish). From the sexually mature spring Chinook salmon returning to the Moving Falls trap, all precocious spring Chinook salmon (mini-jacks and jacks) would be sampled and compared to the older adult population using the ELISA procedure. Chi-square analysis would be used to correlate disease severity as related to age and rearing facility.

The numbers of precociously maturing males would be divided by the total number sampled to estimate the proportion of precocious maturation for each release group. This proportion would be multiplied by the number of smolts in each release group to estimate the percentage of smolts that are mini-jacks. The SAR for the brood year return would be applied to the estimated number of precocious smolts to estimate the number of mini-jacks by release group.

$$\left(\frac{P_i}{I_i} R_i\right) \times SAR_i \tag{3}$$

Where P_i = number of observed precocial males in release group i; L_i = number smolts inspected by release group; and R_i = number of smolts in release group *i*.

The numbers of age 3 jacks returning to Moving Falls weir would be estimated using the methods for determining SARs described below. The proportion of mini-jacks would be estimated by PIT tag detections at Bonneville Dam and in-river harvest and weir monitoring. Smolts detected moving up-stream through Bonneville Dam during 2010 would be considered mini-jacks. An estimate of the number of mini-jacks by release group would be determined by PIT tag detections:

$$\frac{(\text{Bonneville Dam + Harvest + Weir}) \times \text{\# of PIT tags by release group}}{\text{\# PIT tags}} \tag{4}$$

To test the hypothesis that there is no significant difference in rates of precocity among release groups contingency table analysis would be performed ($\alpha = 0.05$). If significant differences exist in jack and mini-jack rates among release groups, the relationship of specific growth rates, condition factor, gonadal maturation and presence of BKD in smolts from each group would be investigated. Multivariate analysis of variance would be conducted to determine if differences exist among release groups.

Smolt-to-Adult Return Survival

Tagged adults from the 2010 release (2008 brood year) would be recaptured in ocean fisheries, Columbia River fisheries, Hood River fisheries, during carcass surveys below the Moving Falls weir, and at the Moving Falls weir during 2011-2014. All adults returning to the Hood River would be sampled for fin-marks and the presence of CWTs and PIT tags when encountered (harvest monitoring, carcass surveys, and the Moving Falls weir). The coast-wide and Columbia River CWT monitoring program randomly samples commercial and recreational fisheries for CWT presence. These sampling programs examine a subset of the total catch. The observed CWTs are expanded for the proportion sampled to estimate the total number of CWT fish that are harvested in each fishery. Refer to the Pacific States Marine Fisheries Commission’s Regional Mark Processing Center for methods used to expand tag recovery at PSMFC.org.

Accounting for fishery exploitation in Columbia River Zone 6 tribal fisheries using CWT recoveries is difficult due to incomplete sampling effort. To estimate harvest between

Bonneville Dam and the mouth of the Hood River, the proportion of PIT tag recaptures of returning adults at Bonneville Dam would be determined and subtracted from subsequent recaptures in the Hood River.

To calculate overall SARs, the sum of the expanded CWT recaptures in the ocean, CWT and PIT tag recaptures in the mainstem and Hood River fisheries, plus total weir and carcass counts would be divided by the number of CWT fish released for each release group:

$$SAR_i = E_i + T_i / N_i \tag{5}$$

where E is escapement, *i* refers to one of the three release groups, R_i is the number of expanded recoveries for group *i*, T_i is total recoveries at Moving Falls weir and downstream carcass surveys, and N_i is the number of CWT fish released in group *i*. To adjust the overall SAR to estimate SARs to the Moving Falls weir, the expanded recaptures in the fisheries and CWTs recovered in carcass surveys downstream of the weir would be subtracted from the Moving Falls weir counts and divided by the number of smolts released by tag group.

To test the Hypothesis: $SAR_{PFF} = SAR_{Pelton} = SAR_{Carson}$ against the alternate hypothesis, contingency table analysis would be performed ($\alpha = 0.05$). For planning historic returns to Powerdale fish trap and Hood River tribal harvest rates at Punchbowl falls were used to predict that approximately 0.25% of each tag group should return to Moving Falls weir. With these assumptions we should have at least an 80% power ($\beta = 0.2$) and $\alpha = 0.05$ to detect a 0. 1% difference in SARs among release groups.

Timeline

The study would begin with the collection of eggs from the 2008 brood year. Eggs would be collected from the 2008-2013 broods to be raised at each facility. The final release would occur during 2015. Results would be evaluated after the return of age V adults from the 2008 brood in 2013. Table 27 below displays the tentative timeline.

Table 27: Timeline for Implementation of the Spring Chinook Comparative Release Study

Brood Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Brood Collection	West Fork Hood	West Fork Hood	West Fork Hood	West Fork Hood	West Fork Hood	West Fork Hood					
Rearing	PFF CG RBH	PFF CG RBH	PFF CG RBH	PFF CG RBH	PFF CG RBH	PFF CG RBH	Rearing Location Decision				
Smolt Release Moving Falls			BY 08	BY 09	BY 10	BY 11	BY 12	BY 13			
Adult Returns to Hood River				BY 08 AgeIII	BY 08 AgeIV	BY 08 AgeV					
					BY 09 AgeIII	BY 09 AgeIV	BY 09 Age V				
						BY 10 AgeIII	BY 10 Age IV	BY10 AgeV			
							BY 11 Age III	BY 11 AgeIV	BY11 AgeV		
								BY 12 AgeIII	BY 12 AgeIV	BY12 AgeV	
									BY 13 AgeIII	BY 13 AgeIV	BY13 AgeV

PFF = Parkdale Fish Facility, CG = Carson National Fish Hatchery; RBH = Round Butte Hatchery

6.2 Watershed Monitoring and Evaluation

The Monitoring and Evaluation (M&E) component of this plan provides a basic outline for monitoring and evaluating the response of the Hood River subbasin to projects implemented under the umbrella of this Master Plan, for the purpose of increasing wild and hatchery-produced anadromous salmonids and to monitor populations in relation to ESA recovery. The grounds for this evaluation are the biological fish objectives defined for each HRPP stock in Coccoli (2004). The objectives presented by Coccoli have been revised based on proposed changes to the HRPP as described in this Master Plan. The HRPP's current biological fish objectives for the program's target species include the following:

6.2.1 Summer Steelhead Objectives

Obj. 1. Achieve and maintain an average annual wild spawning population of 600 adult summer steelhead in the Hood River Subbasin.

Obj. 2. Maintain the unique genetic character of wild summer steelhead in the Hood River Subbasin.

6.2.2 Winter Steelhead Objectives

Obj. 1. Achieve and maintain an average annual wild spawning population of 1,100 adult winter steelhead in the Hood River Subbasin.

Obj. 2. Make 1,150 hatchery winter steelhead available for harvest in the Hood River Subbasin.

Obj. 3. Maintain the unique genetic character of wild winter steelhead in the Hood River Subbasin.

6.2.3 Spring Chinook Salmon Objectives

Obj. 1. Achieve and maintain an average annual wild/natural-origin spawning population of 200 adult spring Chinook salmon in the Hood River Subbasin.

Obj. 2. Make 1,300 hatchery spring Chinook salmon available for harvest in the Hood River Subbasin.

Obj. 3. Retain the genetic integrity of the re-introduced population of wild spring Chinook salmon in the Hood River Subbasin.

6.2.4 Background

The HRPP's existing M&E program has been on-going for over 16 years. This program has a strong track record for providing both local and regional fishery managers with the high precision empirical data required to adaptively manage the Chinook and steelhead stocks within the basin (Olsen 2007, McCanna and Wyatt 2006). The following discussion outlines the proposed M&E program within the context of both the existing program and proposed refinements to the program as presented in this Master Plan.

The M&E component of this Master Plan identifies various strategies that are collectively designed to evaluate whether or not action items implemented under this plan are achieving the subbasin's watershed goal within the context of the biological fish objectives as presented above. The subbasin's biological fish objectives are currently based on various assumptions relative to the Hood River Subbasin's carrying capacity, egg-to-smolt and smolt-to-adult survival rates, pre-spawning mortality rates, and race-specific wild and hatchery escapements to the mouth of the Hood River. Data collected under this M&E plan would be used to refine the estimates of these biological parameters, and by extension to refine the numerical targets identified in the subbasin's biological fish objectives. This Master Plan proposes the continued funding and implementation of strategies designed to collect race and stock specific life history, production, escapement, run size, morphometric, meristic, and genetic information on juvenile and adult life history stages of steelhead and spring Chinook in the Hood River Subbasin. The primary emphasis of the M&E program will be to provide the empirical data that the subbasin's fisheries co-managers require to:

1) Refine the numerical fish objectives for wild summer and winter steelhead and natural-origin spring Chinook to more accurately reflect the subbasin's current and potential species and race specific spawner escapement and smolt production carrying capacities;

2) Refine the numerical fish objectives for subbasin spawner escapement and harvest of summer and winter steelhead and spring Chinook salmon;
3) More accurately estimate and monitor species, race, and stock-specific subbasin smolt-to-adult survival rates;
4) Evaluate existing and proposed acclimation facilities and release strategies;
5) Monitor the incidental catch/take of wild and hatchery summer and winter steelhead and spring Chinook in mainstem Columbia River fisheries;
6) Evaluate the existing Pelton Ladder rearing facility, Columbia Gorge rearing facility, and the proposed expanded hatchery facility at PFF;
7) Develop guidelines for implementing the hatchery supplementation program in a manner that will minimize its impact on indigenous populations of resident and anadromous salmonids; and
8) Develop and refine strategies and guidelines for implementing this Master Plan in a manner that will improve program efficiency and benefits.

A comprehensive M&E program is required, in a narrow sense, to collect the life history and escapement information needed to 1) evaluate this Master Plan relative to its performance criteria, and 2) determine whether or not the assumptions used to develop this Master Plan's biological fish objectives are valid, or need to be revised. However, an effective M&E program should not be strictly limited to collecting only that data required to address subbasin specific data needs. The scope of a strong M&E program should be such that it will provide data that has a much broader regional application. The M&E component of the Master Plan proposes implementing various strategies that have been designed to produce the empirical data which is requested on a regular basis by fisheries managers who have been assigned the task of developing sound biologically-based decisions for protecting runs of steelhead in the Columbia River Basin. The broader regional application of the data gathering efforts of the existing M&E project in the Hood River Subbasin has been recognized by both the Independent Scientific Review Panel (ISRP) and the Independent Scientific Advisory Board (ISAB) and will be critical is determining the success of ongoing ESA recovery efforts. The M&E program outlined in this Master Plan proposes a continuation of the subbasin's existing M&E efforts, but has been designed to provide the flexibility required to address any future data gathering needs that are identified by the Hood River Subbasin's fishery co-managers.

The HRPP's existing M&E project maintains a long-term data set comprised of race and stock specific data relative to the Hood River Subbasin's: 1) smolt production, 2) egg-to-smolt and smolt-to-adult survival rates, 3) harvest, and 4) escapements. Subbasin-specific data is also available on rainbow-steelhead rearing densities and selected physical and environmental constraints limiting subbasin salmonid production. The framework for implementing the newly proposed HRPP's M&E project in the Hood River Subbasin was initially outlined and comprehensively defined in the Hood River and Pelton Ladder Master Plans (O'Toole and ODFW 1991*a*, O'Toole and ODFW 1991*b*, and Smith and CTWSR 1991) and in the Hood River/Pelton Ladder Master Agreement (ODFW and CTWSR Undated*a*). The Master Plans were approved by the Council in 1992 and the Master Agreement was submitted to BPA in 1993. The need for an M&E component to the HRPP was also identified in the Columbia River

Anadromous Fish Restoration Plan of the Nez Perce, Umatilla, Warm Springs, and Yakama Tribes (CRITFC 1996) as one of several actions required to improve wild production in the Hood River Subbasin. The subbasin's existing M&E project also provides information that has regional application in evaluating other programs, projects, and fishery management decisions/actions that directly, or indirectly, impact listed runs of both summer and winter steelhead and spring Chinook salmon in the Columbia River Basin.

In addition to proposing the continuation of the subbasin's existing M&E program, this Master Plan proposes several new studies that address information needs resulting from changes in the spring Chinook salmon program described in this plan. This includes conducting comparative release studies to determine the most beneficial rearing and release strategies from a biological and economic perspective (Section 6.1) and evaluating the relative reproductive success of the re-introduced spring Chinook salmon population.

Strategy 1. Monitor harvest of Hood River stocks of hatchery summer and winter steelhead and spring Chinook salmon (see Coccoli 2004)

Metric: Status and trend monitoring of subbasin harvest in the Hood River Subbasin.

Purpose: Consumptive recreational fisheries currently harvest hatchery summer and winter steelhead and spring Chinook salmon in the Hood River Subbasin. Tribal steelhead fisheries are known to have historically existed in the subbasin, but there is no information to determine historical harvest rates. The primary tribal harvest effort consists of a subsistence spring Chinook salmon fishery in the Hood River Subbasin. Non-tribal run year specific estimates of harvest and exploitation rates in the Hood River Subbasin are summarized for the 1996-2006 run years in Olsen (2007), which are summarized in Table 3 (Chapter 1).

The Hood River Subbasin's numerical harvest objectives were originally defined in the Hood River Subbasin Summary (Coccoli 2000). The harvest objectives were revised downward in 2004 (*see* ODFW and CTWSR Undated*b*), based on data collected on the Hood River Subbasin's existing M&E project. The subbasin's revised harvest objectives were incorporated into the Hood River Subbasin Plan (Coccoli 2004). The proposed harvest objectives in this Master Plan were further refined to make available 1,150 hatchery-origin winter steelhead and 1,300 hatchery-origin spring Chinook salmon for harvest in both sport and tribal fisheries within the Hood River Subbasin. The subbasin's fishery co-managers currently do not propose any harvest objectives for summer steelhead because the endemic population is deemed too low to support harvest, or the annual collection of hatchery broodstock.

Harvest of Hood River stocks of summer and winter steelhead in the mainstem Columbia River directly impacts whether or not fisheries co-managers are able to achieve the numerical spawner escapement objectives defined in this Master Plan. To protect threatened and endangered species of anadromous salmonids in the Lower Columbia River DPS (which includes the Hood River Subbasin), the NOAA Fisheries establishes allowable take limits in mainstem Columbia River non-tribal and tribal fisheries. NOAA Fisheries' proposed maximum allowable winter steelhead take limit for the years 2005-2007 is 6.0% in the non-Indian fishery and 10.7% in the treaty Indian fishery (NMFS 2005). The problem is that preliminary information would suggest the exploitation rate on winter steelhead in the

Bonneville Pool alone likely exceeds 6% and could average as high as 17-18% (Rawding et al. 2005); well above the proposed maximum incidental take limit for the years 2005-2007.

Null Hypothesis*:* The Hood River Subbasin's numerical harvest objectives have not been achieved.

Alternative*:* The Hood River Subbasin's numerical harvest objectives have been achieved.

Timeline: Ongoing

Methods: An annual creel would be conducted to collect the information needed to evaluate whether or not this Master Plan's numerical harvest objectives have been met. The proposed creel would estimate harvest in sport and tribal fisheries located in the Hood River Subbasin. The non-tribal fishery is currently restricted to the mainstem of the Hood River below River Mile (RM) 4.5; which is the site of Powerdale Dam. The potential exists that the non-tribal fishery may be extended beyond RM 4.5 upon removal of Powerdale Dam. Methods for implementing the creel program would require more effort if the fishery is expanded beyond its current boundaries, but the methodologies for estimating non-tribal harvest in the Hood River Subbasin, as described in Olsen (2007), would remain un-changed. The tribal fishery is located primarily at Punchbowl falls at Rm. 0.5 in the West Fork of the Hood River.

Downstream migrant wild and hatchery summer and winter steelhead and spring Chinook salmon smolts would be PIT tagged (*see* Strategy 3) in order to implement a mark and recapture program on returning PIT tagged adults. This effort is primarily designed to 1) collect the empirical information required to refine estimates of harvest and exploitation rates of winter steelhead and spring Chinook salmon in the Bonneville Pool, 2) monitor run timing of lower Columbia River steelhead and spring Chinook salmon through the spring fishery below Bonneville Dam, and 3) provide a mechanism for estimating escapements to the mouth of the Hood River post- Powerdale Dam.

Strategy 2. Monitor spawner escapements of wild and hatchery summer and winter steelhead and spring Chinook salmon to the Hood River Subbasin (see Coccoli 2004)

Metric: Status and trend monitoring of spawner escapements to the Hood River Subbasin.

Purpose: The Hood River Subbasin's numerical spawner escapement objectives were originally defined in the Hood River Subbasin Summary (Coccoli 2000) for summer and winter steelhead and spring Chinook salmon. The spawner escapement objectives were revised downward in 2004 (*see* ODFW and CTWSR Undated*b*), based on data collected on the Hood River Subbasin’s existing M&E project. The subbasin's revised spawner escapement objectives were incorporated into the Hood River Subbasin Plan (Coccoli 2004) and are as follows: 1) to achieve and maintain an average annual spawner escapement of 600 wild adult summer steelhead; 2) to achieve and maintain an average annual spawner escapement of 1,100 wild adult winter steelhead; and 3) to achieve and maintain an average annual spawner escapement of 200 natural-origin spring Chinook salmon. Run year specific estimates of summer and winter steelhead and spring Chinook salmon spawner escapements to the Hood River Subbasin are summarized for the 1991-1992 through 2005-2006 run years in Olsen (2007).

This Master Plan's spawner escapement objectives were developed based on several modeling efforts that incorporated subbasin-specific empirical data collected on the subbasin's existing M&E project. The results and conclusions published in Underwood et al. (2003) and in Coccoli et al. (2004) led to two working hypothesis: 1) that spawner escapement to the Hood River may in some years exceed full seeding levels, and 2) that habitat improvement projects have the potential to increase the subbasin's spawner capacity. Fishery managers consider the information required to reject or accept these hypotheses as important in refining the approach ultimately taken to implement this Master Plan. The approach currently taken to achieve the subbasin's numerically defined spawner escapement objectives has been to 1) restrict harvest of unmarked summer and winter steelhead and spring Chinook salmon, and 2) supplement the Hood River Subbasin with Hood River stock hatchery summer and winter steelhead and Deschutes stock spring Chinook salmon.

The Hood River Subbasin's existing M&E project is just beginning to collect the complete juvenile and adult life history information required to accept or reject this strategies' null hypothesis. Maintaining and expanding on the existing data string is considered particularly important in light of the subbasin's anticipated response to 1) proposed changes in guidelines for implementing the subbasin's existing hatchery supplementation program, 2) several large scale habitat improvement projects (i.e., both proposed and implemented), and 3) the de-commissioning and removal of Powerdale Dam.

Null Hypothesis 1: The Hood River Subbasin's numerical spawner escapement objectives have not been achieved.

Alternative 1: The Hood River Subbasin's numerical spawner escapement objectives have been achieved.

Null Hypothesis 2: Habitat improvement work conducted in the Hood River Subbasin has significantly increased the subbasin's spawner carrying capacity.

Alternative 2: Habitat improvement work conducted in the Hood River Subbasin has not significantly increased the subbasin's spawner carrying capacity.

Timeline: Ongoing

Methods: This Master Plan proposes monitoring adult spawner escapements at adult collection facilities located in the Hood River Subbasin both pre- and post- Powerdale Dam. The existing adult collection facility at Powerdale Dam traps virtually all anadromous salmonids escaping to spawning grounds located in the Hood River Subbasin. The proposed collection facilities post- Powerdale Dam are not expected to sample all summer and winter steelhead and spring Chinook salmon escaping to the available spawning grounds in the Hood River Subbasin.

A rough estimate of the percentage of wild and hatchery steelhead and spring Chinook salmon that do not actively migrate past the post- Powerdale Dam adult collection facilities would be generated by two methods. One estimate would be based upon radio tag distribution studies of hatchery and wild spring Chinook salmon and steelhead. The second estimate would be based on the ratio between the counts of adult salmon and steelhead at Powerdale Dam and counts of adult salmon and steelhead at the proposed post- Powerdale Dam adult collection facilities. The latter estimate can be made only if the proposed post- Powerdale Dam adult collection facilities are fully on line prior to removal of Powerdale Dam. The ratio would be applied to counts at the post- Powerdale Dam adult collection facilities to estimate escapement to the mouth of the Hood River post- Powerdale Dam; in conjunction with subbasin harvest estimates (*see* Strategy 1).

Co-managers are also in the very preliminary stages of looking at various models that might have the potential for predicting wild steelhead and spring Chinook salmon escapements to the mouth of the Hood River. These models would be based on a combination of variables that have been extensively monitored on the subbasin's existing M&E project. These include 1) summer stream flows, 2) the relationship between subbasin smolt production and summer stream flows, 3) the relationship between smolt-to-adult survival rates of wild and hatchery steelhead and spring Chinook salmon, and 4) the estimated PIT tagged: non PIT tagged ratio in the estimate of subbasin smolt production and in adult returns back to Powerdale Dam. The methodologies and guidelines for sampling, handling, identifying, and distributing wild and hatchery adult summer and winter steelhead and spring Chinook salmon collected at adult collection facilities post- Powerdale Dam would likely remain unchanged from those outlined for Powerdale Dam in Olsen (2007).

Strategy 3. Monitor wild pre-smolt and smolt steelhead and spring Chinook salmon production in the Hood River Subbasin (see Coccoli 2004)

Metric: Status and trend monitoring of steelhead and Chinook salmon pre-smolt and smolt production in the Hood River Subbasin.

Purpose: The Hood River Subbasin's wild smolt production capacities are defined for summer steelhead (i.e., 13,860 smolts), winter steelhead (i.e., 16,970 smolts), and spring Chinook salmon (i.e., 15,692 smolts) in Coccoli (2004). Achieving the subbasin's smolt production capacity is inextricably linked with this Master Plan’s numerical fish objectives for subbasin spawner escapement (*see* Strategy 2). The race and species-specific subbasin smolt production capacities defined in Coccoli (2004) were developed based on several modeling efforts that incorporated subbasin-specific empirical data that was collected in the subbasin's existing M&E project. The results and conclusions published in Underwood et al. (2003) and in Coccoli et al. (2004) led to two working hypothesis: 1) that subbasin smolt production in the Hood River may in some years exceed full seeding levels, and 2) that habitat improvement projects have the potential to increase the subbasin's smolt capacity. Fishery managers consider the information required to reject or accept these hypotheses as important in refining the approach ultimately taken to implement this Master Plan.

The numerical fish objectives for wild and hatchery harvest and subbasin spawner escapements are currently based on wild and hatchery steelhead and spring Chinook egg-to-smolt and smolt-to-adult survival rates that were estimated on the subbasin's existing M&E project. Estimates of both harvest and take in the mainstem Columbia River (i.e., Bonneville Pool) are currently based on preliminary estimates provided in Rawding et al. (2005). Continued refinement of wild and hatchery smolt-to-adult survival rates, as they respond to both in-basin and regional efforts to increase adult returns to the Hood River Subbasin, is considered critical to implementing this Master Plan in a biologically sound and economically efficient manner. Also, preliminary data from the subbasin's existing M&E project would suggest that removal of Powerdale Dam will significantly increase the smolt-to-adult survival rate for both wild and hatchery smolts. Accurately determining the degree of change will provide the basis for fishery managers to re-assess the level of hatchery supplementation required to achieve this Master Plan's numerical fish objectives. Data collected under this strategy will provide the basis for refining our estimates of: 1) egg-to-smolt and smolt-to-adult survival rates for wild steelhead, 2) incidental catch of steelhead in spring fisheries below Bonneville Dam, and 3) steelhead and spring Chinook harvest in the Bonneville Pool. The latter two parameters will be evaluated from returning PIT tagged adult steelhead and spring Chinook salmon.

Null Hypothesis 1: Subbasin smolt production has been significantly increased following implementation of this management plan.

Alternative 1: Subbasin smolt production has not been significantly increased following implementation of this management plan.

Null Hypothesis 2: Habitat improvement work conducted in the Hood River Subbasin has significantly increased egg-to-smolt survival rates in the subbasin.

Alternative 2: Habitat improvement work conducted in the Hood River Subbasin has not significantly increased egg-to-smolt survival rates in the subbasin.

Timeline: Ongoing

Methods: The primary focus of this strategy would be to operate and maintain downstream migrant screw traps at selected sites located in the mainstem Hood River; West, Middle, and East forks of the Hood River; and in Lake Branch, a tributary to the West Fork of the Hood River. Sampling sites would be established in areas designed to optimize the number of migrants sampled from populations of summer and winter steelhead and spring Chinook salmon, but consideration would be given to locating traps in areas where opportunities would exist to sample and mark bull trout and cutthroat trout. The migrant traps would be used to enumerate, bio-sample, and PIT tag downstream migrant salmonids and to collect genetic samples from downstream migrants. Historically, trapping sites have allowed annual capture and marking of 2.7 to 7.3% of the subbasin's steelhead smolt production (Olsen 2007).

The migrant traps would be instrumental in providing a mechanism for 1) estimating and monitoring subbasin smolt production; 2) genetically assigning winter steelhead for hatchery broodstock; 3) estimating recruits per spawner for naturally-produced spring Chinook salmon; and 4) estimating winter steelhead and spring Chinook harvest in the Bonneville Pool. Estimates of smolt production would be used to develop models that would: 1) predict annual subbasin steelhead and spring Chinook salmon smolt production from selected physical and environmental factors specific to the Hood River Subbasin, and 2) predict future run sizes of summer and winter steelhead and spring Chinook salmon (i.e., in conjunction with adult counts at collection facilities both pre- and post- Powerdale). Estimates of smolt production would also be used to monitor the subbasin's response to selected habitat improvement work/projects relative to subbasin smolt production. Sampling methods and data analysis are extensively outlined in: 1) Olsen (2007) for estimating smolt production at the downstream migrant traps, 2) Matala et al. (2005) for the broodstock identification project, 3) Olsen (2007) for estimating subbasin smolt production based on summer flows, and 4) Olsen (2007) for smolt PIT tagging.

Strategy 4. Monitor selected life history and phenotypic characteristics of juvenile and adult wild and hatchery steelhead in the Hood River Subbasin (see Coccoli 2004)

Metric: Status and trend monitoring of selected life history and phenotypic characteristics of juvenile and adult summer and winter steelhead in the Hood River Subbasin.

Purpose: The Northwest Power Planning Council (now the NW Power and Conservation Council) expressed a concern during the developmental stage of the HRPP that any hatchery supplementation program in the Hood River Subbasin should be designed and implemented in a manner that minimized any negative impact the program might have on indigenous populations of fish in the Hood River Subbasin. As a consequence, the hatchery supplementation component of the HRPP was designed within the context of achieving two basic principles: 1) to produce a hatchery product that would be both biologically and genetically suited to the Hood River Subbasin, and 2) that all actions implemented under the umbrella of the HRPP would have a minimal negative impact on indigenous populations of fish. Preliminary data collected from the subbasin's existing M&E project indicates that specific management decisions may have initially resulted in: 1) a shift in the run timing of wild and Hood River stock hatchery runs of summer and winter steelhead, 2) the cross breeding of summer and winter steelhead in the hatchery broodstock, 3) a reduction in the genetic fitness of indigenous populations of summer and winter steelhead, and 4) a returning hatchery adult winter steelhead that spawns over a narrow geographic range.

Several of the above problems occurred as an unintended consequence of ongoing activities related to the operational guidelines established for implementing the hatchery supplementation component of the HRPP, but more importantly the subbasin's existing M&E project provided data that identified these problems during the early stages of implementation. As a consequence, fishery managers were able to use the data in the early implementation stages of the HRPP to develop biologically sound measures for correcting the problems.

The subbasin's existing M&E program continues to provide a comprehensive data set that can be used to: 1) monitor the interaction of wild and hatchery (i.e., both indigenous and non-indigenous stocks) components of the summer and winter runs of steelhead and spring Chinook salmon, 2) evaluate the reproductive success of the Hood River stock of hatchery summer and winter steelhead relative to the indigenous wild stocks of summer and winter steelhead, 3) evaluate the reproductive success of the Deschutes stock of hatchery spring Chinook salmon relative to the re-introduced population of spring Chinook salmon, and 4) evaluate and compare selected life history and phenotypic characteristics of wild and hatchery steelhead and natural and hatchery spring Chinook salmon. Without the subbasin's existing M&E program, it is doubtful that fishery managers would have been able to identify any of the potential negative impacts the HRPP might have had on indigenous populations of steelhead; let alone to have identified the problems early on in the implementation phase of the

HRPP. Also, there would have been no empirical data available for fishery managers to use in developing biologically sound corrective measures. The Hood River Subbasin's fishery co-managers consider continued funding and implementation of the subbasin's existing and proposed M&E activities as critical to implementing this Master Plan in a biologically sound manner.

Null Hypothesis 1: Selected life history and phenotypic characteristics of wild and hatchery populations of summer and winter steelhead in the Hood River Subbasin are not significantly different post- implementation of this management plan.

Alternative 1: Selected life history and phenotypic characteristics of wild and hatchery populations of summer and winter steelhead in the Hood River Subbasin are significantly different post- implementation of this management plan.

Null Hypothesis 2: The spatial distribution of naturally-spawning hatchery adult winter steelhead can be significantly expanded by distributing hatchery production releases over a wide geographic range.

Alternative 2: The spatial distribution of naturally-spawning hatchery adult winter steelhead cannot be significantly expanded by distributing hatchery production releases over a wide geographic range.

Timeline: Ongoing

Methods: The adult collection facility at Powerdale Dam has been the cornerstone for providing information critical to monitoring several key biological parameters for wild, natural, and hatchery stocks of steelhead and spring Chinook salmon in the Hood River Subbasin. More importantly, it provides the means for both counting and bio-sampling virtually <u>all</u> steelhead and salmon that will eventually spawn in the Hood River Subbasin. The biological and genetic information gathered at the dam provides a mechanism for accurately estimating in-basin: 1) smolt-to-adult survival rates (i.e., in conjunction with data from the migrant traps [*see* Strategy 3]), 2) escapements to the mouth of the Hood River (i.e., in conjunction with data from the creel [*see* Strategy 1]), 3) adult run timing, 4) adult straying rates, 5) exploitation rates in the non-tribal fishery (i.e., in conjunction with data from the creel [*see* Strategy 1]), and 6) reproductive success of both indigenous and non-indigenous stocks of steelhead and salmon that spawn in the subbasin. The loss of the adult collection facility at the dam makes it unlikely that co-managers will be able to maintain the current sampling rate post- Powerdale Dam. As a consequence, this Master Plans M&E program will be confined to monitoring selected life history and phenotypic characteristics from only those steelhead and salmon escaping to the post- Powerdale Dam adult collection facilities. It is believed, however, that the greater percentage of wild, natural, and hatchery stocks of summer and winter steelhead and spring Chinook salmon escaping to spawn in the Hood River Subbasin would be trapped at the proposed post- Powerdale Dam adult collection facilities. The large sample sizes that are anticipated should allow accurate testing of this strategy's null hypotheses; in conjunction with data collected in the Hood River creel (*see* Strategy 1). The methodologies for sampling and analyzing data should remain unchanged and are extensively outlined in Olsen (2007).

Additional bio-sampling would occur in 1) non-tribal fisheries (*see* Strategy 1) and 2) at juvenile migrant traps (*see* Strategy 3). Additional activities include, 1) monitoring the spatial distribution of wild and hatchery spawners, and 2) collecting and summarizing regional count and bio-data on steelhead that were PIT tagged as juveniles in the Hood River Subbasin. Columbia River Basin PIT tag detection information is available through the PSMFC's Columbia River DART (Data Access in Real Time) PIT tag reporting website (i.e., http://www.cbr.washington.edu/dart/pit_ obs_de.html). Information would be used to: 1) gather both in-basin and out-of-basin life history and incidental catch (i.e., in the mainstem Columbia River) information, and 2) propose and develop strategies designed to optimize the benefits associated with implementation of this Master Plan.

Strategy 5. Monitor population genetic structure, systematics, and distribution of steelhead, cutthroat, and resident rainbow trout populations indigenous to the Hood River Subbasin (see Coccoli 2004)

Metric: Status and trend monitoring of the genetic fitness of naturally-spawning summer and winter steelhead in the Hood River Subbasin.

Purpose: State and federal agencies have established laws and guidelines that identify measures for protecting populations of anadromous salmonids and resident trout. Implementation of these measures in the Hood River Subbasin is problematic given the lack of any historical information to indicate where reproductively isolated populations exist. For some species, the Hood River Subbasin is on the boundary between subspecies, and the taxonomic designation is uncertain. Co-managers currently do not propose investigating the bull trout population because the required level of sampling may detrimentally impact the wild population. The naturally-produced population of spring Chinook salmon would not be investigated because it is believed the indigenous population is functionally extinct. Co-managers do not propose sampling for coho or fall Chinook salmon at this time, but may propose analyzing existing genetic samples, and collecting additional genetic samples in the future, if a review of existing allozyme data indicates that sampling is warranted. There are currently no plans to study mountain whitefish.

The Hood River Subbasin fishery co-managers consider it critically important to monitor, at a genetic level, the interaction between wild and hatchery populations of steelhead. Primarily because of the potential for a high degree of interbreeding that may occur between wild and hatchery populations of steelhead and wild populations for resident rainbow and cutthroat trout. Information gathered under the umbrella of this Master Plan would provide the basis for developing and refining hatchery guidelines for implementing the Hood River Subbasin’s supplementation program in a manner that would provide the greatest degree of protection for indigenous populations of *O. mykiss* in the Hood River Subbasin. It is also anticipated that data collected under this study, when combined with information collected on the subbasin's existing M&E project, would have much broader regional application when developing and implementing biologically sound hatchery supplementation programs in other subbasins.

Null Hypothesis 1: The long-term fitness of wild populations of summer and winter steelhead in the Hood River Subbasin is significantly reduced as a consequence of supplementing the subbasin with Hood River stock hatchery summer and winter steelhead.

Alternative 1: The long-term fitness of wild populations of summer and winter steelhead in the Hood River Subbasin is not significantly reduced as a consequence of supplementing the subbasin with Hood River stock hatchery summer and winter steelhead.

Null Hypothesis 2: The reproductive success of naturally-spawning Hood River stock hatchery summer and winter steelhead significantly differs from the reproductive success of the naturally-spawning wild populations.

Alternative 2: The reproductive success of naturally-spawning Hood River stock hatchery summer and winter steelhead does not significantly differ from the reproductive success of the naturally-spawning wild populations.

Null Hypothesis 3: Wild and Hood River stock hatchery winter steelhead smolts have significantly different smolt-to-adult survival rates (i.e., to the mouth of the Hood River).

Alternative 3: Wild and Hood River stock hatchery winter steelhead smolts do not have significantly different smolt-to-adult survival rates (i.e., to the mouth of the Hood River).

Timeline: Ongoing

Methods: The adult collection facility at Powerdale Dam has been the cornerstone for providing information critical to monitoring the genetic fitness of wild and hatchery stocks of steelhead in the Hood River Subbasin. It has provided biologists the means for counting, bio-sampling, and collecting genetic samples from virtually all adult steelhead that will eventually spawn in the Hood River Subbasin. The ability to sample virtually the entire spawning populations of wild and hatchery steelhead in the Hood River Subbasin has greatly enhanced our ability to evaluate and monitor the reproductive success of several generations of steelhead in the Hood River Subbasin.

Genetic samples were first collected from wild and hatchery winter steelhead beginning with the 1991-1992 run year, and from wild and hatchery summer steelhead beginning with the 1992-1993 run year. Virtually all adult steelhead passed above Powerdale Dam were sampled through the 2007 calendar year, and this policy will continue until the existing adult collection facilities are shut down upon removal of Powerdale Dam. Post-Powerdale Dam, it is unlikely that co-managers will be able to achieve the sampling rate that exists under the current program. As a consequence, this Master Plan's proposed M&E program would be confined to collecting tissue samples from only those steelhead escaping to the post- Powerdale Dam adult collection facilities. It is believed, however, that the greater percentage of wild and Hood River stock hatchery adult summer and winter steelhead escaping to spawn in the Hood River Subbasin would be trapped at the proposed post- Powerdale Dam adult collection facilities. The large sample sizes that are anticipated should allow us to accurately test this strategy's null hypotheses; in conjunction with data collected in the Hood River creel (*see* Strategy 1). Sampling methods and data management protocols should remain unchanged and are extensively outlined in Olsen (2007). Tissue samples collected from both downstream migrant rb-st (*see* Strategies 3 and 4) and upstream migrant adults would be genetically analyzed, evaluated, and summarized based on principles and methodologies that are extensively outlined in Araki and Blouin (2005), Blouin and Araki (2004), Blouin and Araki (2005), Blouin and Araki (2006), Araki et al. (2007*a*), Araki et al. (2007*b*), and Araki et al. (2007*c*).

Strategy 6. Monitor selected physical and environmental constraints that have the potential for limiting wild and natural production of anadromous salmonids in the Hood River (see Coccoli 2004)

Metric: Status and trend monitoring of various physical and environmental constraints limiting the Hood River Subbasin's current and potential carrying capacity for populations of spring Chinook salmon and summer and winter steelhead.

Purpose: Carrying capacity for the Hood River Subbasin is currently estimated based on two computer models: 1) the Unit Characteristic Method (UCM) model, and 2) the Ecosystem Diagnosis and Treatment (EDT) model. Output from both models was derived from subbasin specific physical; environmental; and species, race and stock specific biological data collected from the subbasin's existing M&E project. The subbasin-specific biological and physical data that ultimately drives each model should be updated to include the most current and up-to-date empirical data on: 1) annual estimates of subbasin juvenile and adult salmon and steelhead production (*see* Strategies 1-3); 2) selected life history and phenotypic characteristics of indigenous populations of steelhead and the re-introduced population of spring Chinook salmon (*see* Strategies 4 and 8); 3) the quantity, quality, and diversity of available habitat in the subbasin; 4) summer and winter flows at selected sites in the subbasin; 5) seasonal variations in water temperatures at selected sites in the subbasin; and 6) rearing densities at selected sites in the subbasin.

It should also be noted that none of the core biological and physical data used in the modeling efforts should be treated as static. Habitat improvement work, proposed under the umbrella of this Master Plan, is designed to increase subbasin carrying capacity. The EDT model provides the basis for evaluating the percent change in subbasin carrying capacity that might be anticipated from this plan’s proposed habitat improvement projects, but both the UCM and EDT models lack the empirical data required to accurately quantify the numerical increase in salmonid production that occurs in response to the proposed habitat improvement work. Fishery managers consider it important to monitor both the individual and cumulative benefits of each project. Additionally, these evaluations should take into consideration other land management activities in the drainage that may have the potential for reducing project benefits. Information gathered under this strategy would provide the basis for proposing the most cost effective strategies for improving habitat in the subbasin, and would provide the empirical data required to evaluate each project relative to the projects performance criteria.

Null Hypothesis 1: Habitat improvement work implemented under this plan has significantly enhanced subbasin carrying capacity.

Alternative 1: Habitat improvement work implemented under this plan has not significantly enhanced subbasin carrying capacity.

Null Hypothesis 2: Existing and proposed habitat improvement projects define strategies and tasks that have the potential for significantly improving subbasin carrying capacity.

Alternative 2: Existing and proposed habitat improvement projects define strategies and tasks that do not have the potential for significantly improving subbasin carrying capacity.

Timeline: Ongoing

Methods: Tasks implemented under this strategy would be designed to monitor various physical and environmental parameters that have the greatest potential for limiting salmon and steelhead carrying capacity in the Hood River Subbasin. Specific tasks would include, but not necessarily be limited to, the monitoring of seasonal variation in: 1) stream flow, 2) stream temperatures, 3) rearing densities, and 4) the quality and quantity of specific habitat types. Methodologies are defined in Olsen (2007) for estimating stream flow and in Olsen (1996) for estimating both rearing densities and selected in-stream physical parameters. Methodologies are defined in Moore et al. (1999) for surveying and quantifying stream habitat.

Strategy 7. Monitor indigenous populations of redband/rainbow, cutthroat, and bull trout in the Hood River Subbasin (see Coccoli 2004)

Metric: Status and trend monitoring of indigenous populations of redband/rainbow, cutthroat, and bull trout in the Hood River Subbasin.

Purpose: Ongoing hatchery supplementation programs in the Hood River Subbasin have the potential for negatively impacting endemic species of resident and anadromous salmonids that are not the main target of the program. Non- target indigenous populations of salmonids that are of critical concern include rainbow/redband trout, cutthroat trout, and bull trout. Limited information is available to characterize the status of these populations. It is difficult to either quantify or qualify the potential risks that hatchery supplementation may pose to these populations, primarily because biological systems are highly complex in nature and are not completely understood. However, hatchery summer and winter steelhead can hybridize with indigenous populations of wild steelhead and rainbow trout and the potential exists to reduce the reproductive success of resident populations of trout.

The Hood River Subbasin's fishery co-managers consider some level of population monitoring as critically important for developing biologically sound guidelines that would minimize any negative impacts this Master Plan's proposed hatchery supplementation programs may have on non-target species. A considerable amount of population, biological, and genetic data relative to these indigenous species can be collected in association with activities outlined in Strategies 1-5.

Null Hypothesis 1: The long-term fitness of indigenous populations of redband/rainbow, cutthroat, and bull trout in the Hood River Subbasin is significantly reduced as a consequence of supplementing the subbasin with Hood River stock hatchery summer and winter steelhead.

Alternative 1: The long-term fitness of indigenous populations of redband/rainbow, cutthroat, and bull trout in the Hood River Subbasin is not significantly reduced as a consequence of supplementing the subbasin with Hood River stock hatchery summer and winter steelhead.

Timeline: Ongoing.

Methods: Fishery co-managers propose monitoring the above populations by way of: 1) counting (i.e., relative abundance), bio-sampling, and PIT tagging migrants caught at downstream migrant traps (*see* Strategy 3); 2) counting and bio-sampling species caught in the Hood River creel (*see* Strategy 1); 3) counting, bio-sampling, and PIT tagging upstream migrants caught in adult collection facilities located in the Hood River Subbasin both pre- and post- Powerdale Dam (*see* Strategies 2 and 4), and 4) collecting tissue samples from juvenile and adult redband/rainbow, cutthroat, and bull trout (*see* Strategy 5). The methodologies for sampling and analyzing data, other than those associated with the genetic analysis of tissue samples, are extensively outlined in Olsen (2007). The methodologies for analyzing tissue samples have not as yet been established for redband/rainbow, cutthroat, and bull trout.

Strategy 8. Monitor the reproductive success of natural and hatchery-produced spring Chinook salmon spawning in the West Fork of the Hood River

Metric: Status and trend monitoring of the genetic fitness (recruits per spawner) of natural and hatchery produced spring Chinook salmon spawning in the West Fork (WFk) of the Hood River.

Purpose: Efforts are underway to reintroduce wild populations of Columbia River spring Chinook salmon which were extirpated from the Hood, Umatilla and Clearwater River basins, as well as coho salmon in the Yakima, Wenatchee, Methow, Umatilla and Clearwater River basins. These projects involved initial stocking of juveniles from out-of-basin hatchery stocks, followed with supplementation which progressively phases out use of the out-of-basin broodstock, in favor of "local origin" adults. The local broodstock would initially comprise mature hatchery-origin (HO) adults which are captured upon return to their river of release. In subsequent generations, natural-origin (NO) progeny of the out-of-basin HO adults are/would be incorporated into the broodstock in increasing proportions. The presumption is that the genetic characteristics responsible for successful return and natural breeding of the fish would be inherited by their progeny, reestablishing a population which is increasingly adapted to the local environment, and which may eventually become self-sustaining.

Have these programs been successful in reestablishing natural populations? The signs are encouraging, but not definitive. In addition to observation of substantial numbers of returning adults from the hatchery stockings, natural spawning of a portion of the HO adults has occurred, and juveniles at the fry, parr and out-migrating smolt stages from these spawnings have been recorded. Additionally, it has been observed that increasing numbers of NO fish have successfully out-migrated and returned as mature adults. However, supplementation continues in essentially all of these reintroduction projects, and so demonstration of an independent self-sustainable reintroduced population has not yet been made. Therefore, it remains unproven that the natural production observed in these reintroduction and/or supplementation projects is being maintained by production from an increasingly well adapted wild population, rather than simply production from annual spawning of returning hatchery fish.

Prior to cessation of supplementation in these programs, empirical evidence is needed to illustrate that fitness of the reintroduced population is increasing, and that the programs are indeed on a path to success. Productivity is generally measured as the number of natural recruits per spawner (R/S), enumerated either at a juvenile stage, or as returning adults. However, until recently there was no way to differentiate whether naturally-produced fish were the progeny of natural or of hatchery-origin adults. New molecular genetics techniques now provide a means to perform parentage analysis of naturally-produced individuals, and to estimate the relative reproductive success (RRS) of natural and hatchery-origin adults within brood years.

Data from (RRS) studies of reintroduced populations would also inform RRS studies of supplementation programs conducted on depressed natural populations. Supplementation is designed to provide rapid increases in abundance of a spawning population, using hatchery management protocols designed to produce fish with reproductive characteristics similar to those of natural-origin fish (RASP 1992, Cuenco et al. 1993). However, there is concern that despite the management modifications, hatchery rearing will inevitably engender some level of genetically-based domestication, which will result in a reduction in the natural fitness of supplemented population, and negate any short term demographic benefits (ISRP and ISAB 2005). While theoretical models to describe effects of supplementation on natural population fitness indicate how domestication effects can decrease population fitness, they also illustrate how natural selection can act to reverse these effects. The models propose that over generations, fitness of the supplemented populations will reach a theoretical equilibrium, determined by the strength of selection in the hatchery and natural environments, the proportion of hatchery and natural-origin fish in the broodstock and in the wild escapement, trait heritability, and the duration of the program (Ford 2002, Busack et al. 2005). To date, however, RRS studies on supplemented populations have focused exclusively on testing for a decrease in natural productivity (e.g., Araki et al. 2007*a*; Araki et al. 2007*b*). In contrast, RRS studies of reintroduced populations can study the reverse effect. Reintroduction of an extirpated population must necessarily begin with stocking of an out-of-basin hatchery stock, which can be presumed to be relatively ill-adapted to the natural environment. However, natural selective forces should act to remove deleterious hatchery traits as the stock "re-naturalizes", which should be reflected in an increase in RRS over time.

Reintroduction of spring Chinook to the Hood River began in 1988 with releases of out-of-basin Carson Hatchery stock smolts, and continued annually through 1992. In 1993, the program changed to reintroduction of smolts produced from Deschutes River stock– a stock presumably of closer genetic identity to that of the extinct Hood River population, due to the geographic proximity of the two watersheds. From 1993 to 1995 the smolts were direct released into the river, and from 1995 to present the smolts have been acclimated. Scale samples (which provide a source of DNA as well as age information) and basic physical measurements have been collected at Powerdale Dam from all returning adults beginning with the 1992 brood year. Additional sampling is planned until 2010, when the dam is scheduled for removal. Availability of these archived scale samples provides an especially unique opportunity to make a retroactive assessment of trends in productivity of the natural population created by this reintroduction program. Parentage analysis of these scales will provide individual and mean estimates of adult recruits per natural spawner ($R_{(adults)}/S$) for 14 full brood years (1992 until 2005).

The natural productivity of a reintroduced population is expected to increase when hatchery supplementation switches from use of out-of-basin to local broodstock (e.g., from Carson hatchery stock, to Deschutes River stock), and when natural spawning is predominated by NO adults rather than HO adults. As such, the expectation for the reintroduced Hood River spring Chinook is that there will be a trend for increasing $R_{(adults)}/S$ for NO adults over the years since reintroduction.

Null Hypothesis: The reproductive success of naturally-spawning Deschutes stock hatchery spring Chinook salmon significantly differs from the reproductive success of the re-introduced naturally-spawning population.

Alternative Hypothesis: The reproductive success of naturally-spawning Deschutes stock hatchery spring Chinook salmon does not significantly differ from the reproductive success of the re-introduced naturally-spawning population.

Timeline: Ongoing through 2010.

Methods: Archived scale samples would be assembled, enumerated, and verified for presence of age and ancillary data on sex and physical measures. Additional samples would be collected until 2010 when the dam is scheduled to be removed. Molecular genetics analysis would be performed on each of these archived samples from NO fish. The analyses would follow procedures similar to those employed to determine parentage of Hood River steelhead (e.g., Araki et al. 2007*a*; Araki et al. 2007*b*), but using microsatellite loci informative for spring Chinook salmon (e.g., Leth 2005, Murdoch et al. 2006, Seeb et al. 2007). Briefly, these analyses would consist of extraction of DNA from each scale, and analysis of the DNA for the allelic composition at 13 different microsatellite loci. The date of collection for each scale would identify the fish as a potential spawner for that brood year and, and the age data would identify each as the adult progeny from a preceding brood year. Parentage analysis would then be performed by comparing the genetic profiles for each fish with those of all potential NO spawners within its brood year, to identify those with one or two NO parents. The total number of adult progeny assigned to each NO parent ($R_{(adults)}/S$) would be calculated, and averaged within brood years (fish for which only one or no NO parents would be presumed to be the progeny of HO parents). RRS values would then be calculated for the NO fish within brood years by dividing the mean Hood River $R_{(adults)}/S$ values by the corresponding value for the HO spring Chinook reference population. The RRS ratios would be graphed over time, and the graph evaluated for a trend of increasing RRS.

CHAPTER 7: SCHEDULE AND COSTS

Design & Construction Costs										
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
East Fork Adult Trap & Barrier	$250,000									
West Fork Adult Trap & Barrier	$500,000									
Moving Falls Rearing Site	$290,000					$1,553,750				
Parkdale Fish Facility	$175,000				$425,000					
Total Capital Costs:	**$965,000**	**$0**	**$0**	**$0**	**$425,000**	**$1,553,750**	**$0**	**$0**	**$0**	**$0**
Operation & Maintenance										
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
East Fork Adult Trap & Barrier	$46,580	$47,977	$49,417	$50,899	$52,426	$53,999	$55,619	$57,288	$59,006	$60,776
West Fork Adult Trap & Barrier	$90,420	$93,133	$95,927	$98,804	$101,769	$104,822	$107,966	$111,205	$114,541	$117,978
Moving Falls Acclimation Site (includes winter steelhead acclimation in East Fork)	$10,000	$59,657	$61,447	$63,290	$65,189	$67,144	$69,159	$71,234	$73,371	$75,572
Parkdale Fish Facility Adult Holding & Juvenile Production (30k Chinook smolt & winter steelhead program)	$355,366	$366,027	$377,008	$388,318	$399,968	$411,967	TBD	TBD	TBD	TBD
Pelton /Round Butte Hatchery rearing (ODFW) for 75K smolt. Includes marking, fish health & transportation.	$123,165	$126,860	$130,666	$134,586	$138,623	$142,782	TBD	TBD	TBD	TBD

Carson National Fish Hatchery rearing (USFWS) for 45k smolt. Includes marking, fish health & transportation.	$35,077	$39,286	$44,001	$49,281	$55,194	$61,818	TBD	TBD	TBD	TBD
ODFW Oak Springs Hatchery (50k winter steelhead smolt). Includes marking, fish health & transportation.	$125,000	$128,750	$132,613	$136,591	$140,689	$144,909	$149,257	$153,734	$158,346	$163,097
Total Operation & Maintenance:	**$648,608**	**$720,580**	**$745,733**	**$772,065**	**$799,663**	**$828,620**	**TBD**	**TBD**	**TBD**	**TBD**
Monitoring and Evaluation										
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
CTWSR Chinook	$520,670	$499,205	$623,645	$539,355	$555,536	$572,202	$589,368	$607,049	$625,260	$644,018
USFWS Hatchery Eval. BKD Study	$1,821	$6,040	$6,040	$6,070	$6,100	$6,131				
USFWS Hatchery Eval. Data Analysis	$6,217	$3,369	$3,474	$3,580	$7,370	$8,002				
ODFW Steelhead	$591,000	$622,000	$655,000	$655,000	$689,000	$689,000	$752,000	$752,000	$792,000	$834,000
Total M&E:	$1,119,708	$1,130,614	$1,288,159	$1,204,005	$1,258,006	$1,275,335	$1,341,368	$1,359,049	$1,417,260	$1,478,018

Note: Costs are not adjusted for inflation. They also do not include costs for easements at the acclimation and trap sites.

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APPENDICES

APPENDIX A: GLOSSARY

Glossary

Abundance Index – Information obtained from samples or observations and used as a measure of the weight or number of fish which make up a stock.

Acclimate – The adaptation of an organism to environmental changes.

Acclimation pond – Concrete or earthen pond or a temporary structure used for rearing and imprinting juvenile fish in the water of a particular stream before their release into that stream.

Adfluvial – Possessing a life history trait of migrating between lakes or rivers and streams.

Adipose fin – A small fleshy fin with no rays, located between the dorsal and caudal fins.

Age-class – A group of individuals of a certain species that have the same age.

Alevin – The developmental life stage of young salmonids and trout that are between the egg and fry stage. The alevin has not absorbed its yolk sac and has not emerged from the spawning gravels.

Anadromous – Fish that hatch rear in fresh water, migrate to the ocean (salt water) to grow and mature, and migrate back to fresh water to spawn and reproduce.

Broodstock – Adult fish used to propagate the subsequent generation of hatchery fish.

Captive broodstock – Fish raised and spawned in captivity.

Catch Per Unit Of Effort – The catch of fish, in numbers or in weight, taken by a defined unit of fishing effort. Also called; catch per effort, fishing success, availability.

Caudal – Pertaining to the tail.

Caudal fin – The tail fin.

Caudal peduncle – The tapering portion of a fish's body between the posterior edge of the anal fin base and the base of the caudal fin.

Cobble – Rock smaller than boulder and larger than gravel; arbitrarily 1 to 50 pounds or 2 to 8 inches in diameter.

Coded-wire tag (CWT) – A small (0.25mm diameter x 1 mm length) wire etched with a distinctive binary code and implanted in the snout of s salmon or steelhead, which, when retrieved, allows for the identification of the origin of the fish bearing the tag.

Dorsal fin – The fin located on the back of fishes, and in front of the adipose fin, if it is present.

Dorsal fin ray – Refers to one of the cartilaginous rays (stiff rods) located in the membrane of a dorsal fin.

Egg take – The number of eggs taken at hatcheries when adult salmon and steelhead are spawned.

Egg-to-smolt survival – The numerical difference between the number of fertilized eggs produced by a groups of fish and the number of smolts resulting from those eggs.

Embeddedness – The degree to which fine sediment is mixed in with spawning gravel.

Embryo – The early stages of development before an organism becomes self supporting.

Emergence – The process during which fry leave their gravel spawning nest and enter the water column.

Emigration – Referring to the movement of organisms out of an area. See immigration and migrating.

Escapement – the number of fish allowed to escape the fishery and spawn.

Exploitation rate – The proportion of a population at the beginning of a given time period that is caught during that time period (usually expressed on a yearly basis). For example, if 720,000 fish were caught during the year from a population of 1 million fish alive at the beginning of the year, the annual exploitation rate would be 0.72.

Extirpate – The elimination of fish or another species from a geographic area.

Eyed egg – A fish egg containing an embryo that has developed enough so the eyes are visible through the egg membrane.

Fall-run fish – Anadromous fish that return to spawn in the fall.

Fecundity – The total number of eggs produced by a female fish.

Fingerling – Refers to a young fish in its first or second year of life.

Fishing Mortality – Deaths in a fish stock caused by fishing.

Fitness – The reproductive success of a genotype, usually measured as the number of offspring produced by an individual that survive to reproductive age relative to the average for the population.

Fishway – A device made up of a series of stepped pools, similar to a staircase, that enables adult fish to migrate up the river past dams.

Fluvial – Migrating between main rivers and tributaries. Of or pertaining to streams or rivers.

Fry – A stage of development in young salmon or trout. During this stage the fry is usually less than one year old, has absorbed its yolk sac, and is between the alevin and parr stage of development.

Gills – The fleshy, and highly vascular organs comparable to lungs used in aquatic respiration.

Gravel – See cobble.

Homing – The ability of a salmon or steelhead to correctly identify and return to their natal stream, following maturation at sea.

Immigration – Referring to the movement of organisms into an area. See emigration and migrating.

Imprinting – The physiological and behavioral process by which migratory fish assimilate environmental cues to aid their return to their stream of origin as adults.

Inbreeding – Mating or crossing of individuals more closely related that average pairs in the population.

Incubation – The period of time from egg fertilization until hatching.

Jack -Refers to the small percentage of salmon returning to fresh water from the ocean after only one year. Generally a 3-year old fish.

Juvenile – Fish from one year of age until sexual maturity.

Kelt – A spent or spawned out steelhead salmon.

Littoral zone – The region of land bordering a body of water.

Macroinvertebrate – Invertebrates visible to the naked eye, such as insect larvae and crayfish.

Migrant – Life stage of anadromous and resident fish species which moves from one locale, habitat or system (river or ocean) to another.

Migrating – Moving from one area of residence to another.

Mini-Jack – Refers to the small percentage of salmon that do not migrate to the ocean, rather they remain in freshwater and return to natal streams the same year they are released as smolts.

Mixed stock – A stock whose individuals originated from commingled native and non-native parents; or a previously native stock that has undergone substantial genetic alteration.

Mortality – The number of fish lost or the rate of loss.

Natal – Birth place.

Natal stream – Stream of birth.

Naturally-spawning populations – Populations of fish that have completed their entire life cycle in the natural environment without human intervention.

Outmigration – The migration of fish down the river system to the ocean.

Outplanting – Hatchery reared fish released into streams for rearing and maturing away from the hatchery sites.

Parr – The developmental life stage of salmon and trout between alevin and smolt, when the young have developed parr marks and are actively feeding in fresh water.

Parr marks – Distinctive vertical bars on the sides of young salmonids.

Passive Integrated Transponder (PIT) tags – Passive Integrated Transponder tags are used for identifying individual salmon for monitoring and research purposes. This miniaturized tag consists of an integrated microchip that is programmed to include specific fish information. The tag is inserted into the body cavity of the fish and decoded at selected monitoring sites.

Pre-smolt – A juvenile salmon or steelhead that has not yet reached the physiological state known as a smolt.

Pre-spawning mortality – Generally refers to non-fishery mortality of adult salmon and steelhead between the time the fish enter the Columbia River and the completion of spawning.

Precocious – Fish that have matured quickly, or faster than the remaining fish of its age-class.

Predation – Hunting and killing another animal for food.

Production – 1. The total elaboration of new body substance in a stock in a unit of time, irrespective of whether or not it survives to the end of that time. Also called; *net production ; *total production. 2. *Yield.

Radio-telemetry – Automatic measurement and transmission of data from remote sources via radio to a receiving station for recording and analysis.

Rear – To feed and grow in a natural or artificial environment.

Rearing – Refers to the amount of time that juvenile fish spend feeding in nursery areas of rivers, lakes, streams and estuaries before migration.

Recruitment – The amount of fish added to the exploitable stock each year due to growth and/or migration into the fishing area. For example, the number of fish that grow to become vulnerable to the fishing gear in one year would be the recruitment to the fishable population that year. This term is also used in referring to the number of fish from a year class reaching a certain age. For example, all fish reaching their second year would be age 2 recruits. Recruitment Curve, Reproduction Curve; A graph of the progeny of a spawning at the time they reach a specified age (for example, the age at which half of the brood has become vulnerable to fishing), plotted against the abundance of the stock that produced them.

Recruits – The total numbers of fish of a specific stock available at a particular stage of their life history.

Redd – A nest of fish eggs covered with gravel.

Relative Abundance – An estimate of actual or absolute abundance; usually stated as some kind of index; for example, as bottom trawl survey stratified mean catch per tow.

Resistance Board Weir – A type of fish barrier that allows for control of upstream migrations. These systems are installed on or adapted to existing concrete sills, new concrete sills, removable steel sills, or cable sills and have the ability to withstand high flows by lying flat against the river surface.

Run (of fish) – A group of fish of the same species that migrate together up a stream to spawn, usually associated with the seasons, e.g., fall, spring, summer, and winter runs. Members of a run interbreed, and may be genetically distinguishable from other individuals of the same species.

Salmonid – Fish of the family Salmonidae, that includes salmon and steelhead.

Sand – Small substrate particles, generally referring to particles less than 2 mm in diameter. Sand is larger than silt and smaller than cobble or rubble.

Sediment – The organic material that is transported and deposited by wind and water.

Silt – Substrate particles smaller than sand and larger than clay.

Smolt – Refers to the salmonid or trout developmental life stage between parr and adult, when the juvenile is at least one year old and has adapted to the marine environment.

Smoltification – Refers to the physiological changes anadromous salmonids and trout undergo in freshwater while migrating toward saltwater that allow them to live in the ocean.

Smolt-to-Adult Ratio – Represents the survival from a juvenile leaving the subbasin to an adult returning.

Spawn – The act of reproduction of fishes. The mixing of the sperm of a male fish and the eggs of a female fish.

Stock – A specific population of fish spawning in a particular stream during a particular season.

Straying – A natural phenomena of adult spawners not returning to their natal stream, but entering and spawning in some other stream.

Subyearling – A developmental life stage of fish that are less than one year old.

Swim-up fry – A salmonid fry that is swimming in the water column in search for food.

Weir (fish trap) – Usually a barrier constructed to catch upstream migrating adult fish.

Wild populations – Fish that have maintained successful natural reproduction with little or no supplementation from hatcheries.

Wild stock – A stock that is sustained by natural spawning and rearing in the natural habitat, regardless of parentage (includes native).

Yearling – A one year old fish.

APPENDIX B: ISRP THREE-STEP REVIEW QUESTIONS

A. All Projects

Does the Master Plan:

1) Address the relationship and consistencies of the proposed project to the eight scientific principles (see 2000 Columbia River Basin Fish and Wildlife Program, Basinwide Provisions, Section B.2) (Step 1)?

The eight scientific principles:

1. The abundance, productivity, and diversity of organisms are integrally linked to the characteristics of their ecosystem.

The Master Plan considers how suitable habitats, relating both to quality and availability, contribute to the productivity of spring Chinook and steelhead. The document specifically considers the results of two modeling exercises used to determine the factors limiting salmonid production within the Hood River Subbasin. In 2003, S. P. Cramer and Associates employed the Unit Characteristic Method (UCM) to develop carrying capacities for spring Chinook salmon and steelhead as part of a review of the Hood River Production Program. In 2004, through the process of developing a subbasin plan for the Hood River, the Ecosystem Diagnostic and Treatment model (EDT) was employed to determine the factors limiting production as well as the effect of various habitat treatments on production.

Key findings from the UCM modeling showed that a lack of pool habitat, combined with low wood complexity, high fines, and high turbidity were key factors limiting freshwater capacity and survival within the Hood River Subbasin. Flow enhancement was also found to increase capacity significantly. UCM modeling showed that if flows were increased an additional 10 cfs at each of the major irrigation diversions (EFID, Dee, and FID) as well as return 250 cfs at Powerdale Dam, steelhead parr capacity would increase by 10,000-20,000 and spring Chinook capacity would increase by 7,500-12,500 parr, although the authors admit that the methodology for obtaining these estimates are somewhat dubious (Underwood et al. 2003).

Key findings from EDT showed that the five primary limiting factors in the subbasin were channel stability, habitat diversity, flow, sediment load, and key habitat quantity (Coccolli 2004). Building on the limiting factors analysis, the Program Review determined the juvenile rearing carrying capacity of the West Fork Hood River upstream of Moving falls, specifically to determine estimates for juvenile spring Chinook. Using these carrying capacity estimates, the updated HRPP would adaptively manage the number of natural adults passed upstream of the proposed barrier at this location based on fecundity and egg-to-smolt survival estimates. Thus, the abundance and capacity of spring Chinook in this ecosystem was analyzed with emphasis on available habitat, with the knowledge that organisms within the system are integrally linked to each other. More information regarding how the Master Plan addresses this principle is available in Chapters 1, 4 and 5 of the document. Chapter 5 specifically addresses habitat improvement techniques proposed for various West Fork reaches.

In response to the findings of the UTM modeling and EDT analysis, the HRPP is proposing habitat restoration actions to address limiting factors.

2. Ecosystems are dynamic, resilient and develop over time.

The updated Master Plan addresses the dynamic nature of the Hood River system, and specifically recognizes that existing characteristics of the basin, and its ability to provide habitat for anadromous salmonids, are shaped by these conditions. The West, Middle and East forks that form the mainstem Hood River are each uniquely capable of supporting particular populations that have adapted, over time, to utilize habitats provided by each tributary. For example, the West Fork receives the greatest amount of precipitation, on average, followed by the Middle Fork and East Fork. The climate during the last ten years has exhibited extreme precipitation in excess of 135% of average snow pack and rainfall. This above-average precipitation has directly affected the hydrograph of the Hood River and its forks. The West Fork contributed the greatest percentage of flow (43%), followed by the East (41%) and Middle (16%) forks.

In consideration of the variable climate and resulting hydrograph, habitat conditions in each system are highly dynamic. The proposed rearing facility and adult collection traps consider these issues with respect to placement, available habitat, trapping efficiency with regard to hydrograph and bedload movement, and installation methodologies. More information regarding the Hood River ecosystem and the proposed response of the Master Plan with respect to consideration of specific habitat parameters can be found in Chapters 1, 2, 3 and 4, and Appendix C.

3. Biological systems operate on various spatial and time scales that can be organized hierarchically.

The Master Plan addresses the principle that biological processes are hierarchical. Ultimately, climate shapes hydrology, which in turn shapes the habitat within which species occur. Appendix C provides an analysis of the existing system with respect to the various environmental factors that serve as drivers for determining habitats and species occurrence within those habitats. Ultimately, habitat and salmonid life history are integrally linked. Increases in habitat abundance, diversity and connectivity increase salmonid life history diversity. Increased habitat and life history diversity result in greater production and, ultimately, greater success of a particular population.

In the Hood River system, glacial activity directly affects the physical composition of each tributary, including water quality and content, which subsequently determines what stock can utilize a system most effectively. This principal was directly considered in the development of the new adult trapping facilities as each trap is intended to target a specific population. Additionally, hydrologic characteristics and habitat were used to determine the best fit with regard to salmonid production at the Moving Falls facility. More information regarding how the Master Plan addresses this principle is available in Chapters 1, 2, 3 and 4, and Appendix C of the document.

4. Habitats develop, and are maintained, by physical and biological processes.

Similar to principle 3, the Master Plan considers the fact that habitat is ultimately shaped by climate, hydrology, and geologic characteristics, as well as biological processes including species utilization and contribution to nutrient loading. These factors are addressed in Appendix C and D of the document. The Hood River is a dynamic system, with two of the three tributary forks highly influenced by glacial activity, which determines what species spawns where, and when. The physical characteristics of the aquatic and riparian landscape can change dramatically in a short period of time. The HRPP recognizes this, and has considered this principal in the selection of the new spring Chinook rearing location, as well as the new adult trapping locations with respect to each managed stock. See Section 2.2.1 and Chapters 3 and 4 for more information.

5. Species play key roles in developing and maintaining ecological conditions.

Historically, large numbers of salmonid carcasses provided entire watersheds with nutrients derived from the ocean. Diminished populations and transport of these nutrients out of watersheds has caused a nutrient deficiency compared to times when populations were large. This nutrient deficiency may be hampering recovery of salmon and other animal populations. More spawners translate into higher nutrient loads and more energy-rich detritus for fauna, which, in turn could provide more nutrients for fish.

As presented in Appendix C of the Master Plan, harvest records indicate that thousands of steelhead returned to Hood River each year during the 1960s. This indicates a strong presence of steelhead throughout the basin and has likely affected the productivity (nutrient cycling) and abundance of many other aquatic organisms throughout the basin. The HRPP's intent of reducing the risk of extirpation of steelhead from the basin directly considers this objective as this species indeed plays a key role in the development and maintenance of ecological conditions in the Hood River Basin. Although spring Chinook likely did not occur as abundantly as steelhead, native Hood River spring Chinook likely filled a unique niche in the system and contributed to the productivity of the system, specifically related to marine nutrient supplementation. It should be noted that fall Chinook and coho were historically abundant in the basin.

6. Biological diversity allows ecosystems to persist in the face of environmental variation.

As stated in response to Principles 3 and 4, increased biological diversity can be attributed, in part, to increased habitat diversity. As presented in Chapter 5, the CTWSR proposes habitat enhancement along several reaches of the Hood River and associated tributaries with the intent of increasing local habitat diversity and availability. HRPP co-managers actively engage in basin-wide habitat restoration in partnership with the Hood River watershed group (although activities are outside the scope of this document).

With regard to the production component, the HRPP currently collects broodstock from across the entire returning adult population as a representative sub-sample of the whole population. This collection method ensures that all life history types in relation to spawn timing are represented in the broodstock, which increases the biological diversity of hatchery fish. Utilizing acceptable hatchery spawning protocols and an integrated program maximizes genetic diversity and population fitness to the extent possible. An integrated hatchery program is associated with a specified natural population from which gene flow occurs. The intent of an integrated program is to demographically increase the abundance of fish representing a natural population (two environments, one gene pool). A relatively large and diverse gene pool, into which natural fish are infused from time to time, promotes genetic integrity, increases the population fitness, and reduces the potential for bottlenecks that may make populations more susceptible to dramatic shifts in environmental conditions, such as those that occur in the Hood River Basin.

The spring Chinook and steelhead M&E program (Chapter 6) presented in the updated Master Plan proposes a continuation of the HRPP's existing M&E program, and has been designed to provide the needed flexibility required to address any future data gathering needs that are identified by the Hood River Subbasin's fishery co-managers.

7. Ecological management is adaptive and experimental.

This principal has been applied since the HRPP was initiated. The updated Master Plan maintains the consideration of this principal, particularly in the analysis and monitoring of the spring Chinook component, to ensure that management objectives make biological sense. The proposed comparative release evaluation study for spring Chinook is intended to determine which rearing locations would produce the least precocity and highest SARs (see Sections 1.1, 3.3 and 6.1 for more details), with a strategy for rearing all spring Chinook salmon in the Hood River Basin.

The proposed cessation of the summer steelhead program considers the findings of several recent studies, particularly Araki et al. (2007) that suggest that use of second generation captive-reared fish for broodstock is detrimental to reproductive fitness. Because the summer steelhead stock is at risk of extirpation, the availability of wild broodstock is limited for hatchery use and the continuation of current hatchery practices could potentially harm the wild populations. Araki et al. (2007) found that the fitness of naturally-produced fish born of wild (W) and hatchery-reared (H) parents (W x H) is significantly lower than that of fish born of only wild parents when hatchery-reared parents are second generation captive-reared (Araki et al. 2007). Therefore, release of hatchery-reared fish into the wild that may return as adults and spawn with wild fish could potentially harm the natural population. This same premise applies to winter steelhead, and programs will be adjusted to address the need for wild or first-generation captive-reared broodstock in future production.

Other reasons for discontinuing the summer steelhead program are based on adaptive management and consideration of the existing program. At this time, it is estimated that too many hatchery-reared fish will escape and successfully spawn in the wild, which is in violation of current HSRG straying criteria (less than 5%). Additionally, the lack of sufficient wild returns makes it difficult to use wild broodstock without taking more than 25% of the returning population. The future decision regarding whether to reinitiate the summer steelhead program will occur if the need is apparent, and under consultation with NOAA Fisheries (see Chapters 1 and 2).

The proposed program modifications are the result of on-going program reviews and consideration of new science. The Hood River system itself will undergo a major modification with the removal of Powerdale Dam, and management of anadromous stocks must adjust to that change. Trial and error with regard to upstream passage at proposed barriers is inherent in this program as modifications will be made, if needed, as a result of M&E efforts and determinations. The HRPP has been in operation for over 15 years. Throughout the course of implementation, co-managers have identified aspects of the HRPP that are resulting in reduced success such as rearing spring Chinook in Pelton Ladder for release in the Hood River and identified procedures providing success such as the winter/summer steelhead adult return identification procedures. This type of adaptive management must occur for this program to be successful in maintaining a viable steelhead population, re-establishing spring Chinook, and satisfying tribal and recreational harvest objectives.

8. Ecosystem function, habitat structure and biological performance are affected by human actions.

Human actions, including the construction and operation of the Columbia River hydrosystem, have directly affected ecosystem function, habitat structure and biological performance. The HRPP was developed in response to those effects and consideration of this principle is interlaced within the foundation of program objectives. Activities related to forestry, road building and ranching have resulted in decreased riparian function along many streamside corridors of the Hood River system. In response to those actions, various entities, including the USFS and the CTWSR, have undertaken numerous riparian habitat enhancement projects ranging from the addition of LWD to streamside fencing for cattle exclusion. The CTWSR's tribal need for salmon harvest in the Hood River has a long traditional history, and these actions are intended in part to benefit that need.

Another human action requires direct consideration in the updated HRPP Master Plan. Removal of Powerdale Dam will restore a more balanced, natural ecosystem. The planned decommissioning and removal of the Powerdale Dam in the lower Hood River will benefit salmonid species through the removal of a barrier to natural upstream migration. With this removal comes a variety of management challenges, which have been addressed through the development of the current HRPP goals and objectives, as presented in the Master Plan (see Chapters 3 and 4). Specifically, the need for adult collection would be met by the development of two new facilities that would trap fish in the systems to which they naturally migrate. Removal of Powerdale Dam, therefore, will allow a more complete migration to natal waters and eliminate a management facility in the lower river.

2) Describe the link of the proposal to other projects and activities in the subbasin and the desired end-state condition for the target subbasin (Step 1)?

The link to other programs in the subbasin was presented in Section 1.3. Specifically, on-going and proposed habitat restoration is aimed at increasing wild steelhead and Chinook production commensurate with recommended in the Hood River watershed action plan and the Lower Columbia Recovery Plan.

The desired end-state condition of the revised Master Plan is to improve upon and continue the goals of the HRPP as presented in the 1991 HRPP Master Plan. These goals include the re-establishment of a wild population of spring Chinook in the basin, the establishment of an adequate tribal and non-tribal fishery, and the reduction of the demographic risk of extirpation of winter and summer steelhead. Based on adaptive management and best available science, the summer steelhead program will be discontinued.

As one of the primary desired end states of this program is the establishment of a wild component of spring Chinook in the basin, it is imperative that flexibility is considered in management objectives. Adaptive management of this stock will continue following installation of the new floating weirs to determine how many wild fish are passed upstream based on the concepts of carrying capacity and competition as related to fitness of the population.

3) Define the biological objectives (see 2000 Columbia River Basin Fish and Wildlife Program, Basinwide Provisions, Section C.2 (1) and (2), and Technical Appendix) with measurable attributes that define progress, provide accountability and track changes through time associated with this project (Step 1)?

The biological objectives describe the conditions that are needed to achieve the goal of the program. For the HRPP, those objectives are based on the anadromous fish losses occurring as a result of the development of dams in the region. The overriding objective of all Master Plans is to specifically outline and define a program in relation to how it proposes achieving a set of programmatic goals and objectives. More specifcally in the case of this program, how the actions proposed in this Master Plan contribute to halting the decline of anadromous species above Bonneville Dam, and to restoring and increasing populations of steelhead and salmon to healthy levels over the next two decades.

With regard to the HRPP, the biological performance of spring Chinook and summer and winter steelhead has been the subject of M&E plans since program inception. The objectives of the currently proposed program include the development of adult collection facilities to replace those lost with Powerdale Dam decommissioning, the continuation of one successful steelhead supplementation programs and the cessation of another, and the continuation of efforts to increase the natural spring Chinook component in the basin based on analysis of rearing techniques and habitat modeling conducted in the West Fork tributary (Underwood et al. 2003). All goals of the HRPP are consistent with the biological objectives established by the NPCC. These goals are defined throughout the Master Plan, but are specifically discussed in Chapters 1, 2 and 3.

The HRPP was subjected to quantitative review and analysis under the Program Review (Underwood et al. 2003). The primary objective of the Review was to determine if program goals (and ultimately biological objectives) were being achieved, and if modifications to program activities would be necessary in order to meet or revise program goals or objectives.

As a result of the Review, co-managers re-evaluated rearing techniques and escapement objectives. As presented in Chapters 1 and 3, a comparative study will be conducted to determine if rearing of spring Chinook in-basin is feasible, and biologically favorable with regard to size at release, rates of precocity, and SARs. Future in-basin rearing is anticipated to accomplish two major objectives: 1) reduce stray rates since fish will be reared as juveniles in their natal basin, and 2) reduce jacking since fish will be reared on cooler Hood River water, which will allow development to occur at a more natural rate. A reduction in jacking is expected to significantly improve the smolt-to-adult return rate since fish will not be "lost" to maturation due to jacking and resultant residualism.

The on-going M&E program has undergone some changes based on the proposed program modifications. The M&E plan, presented in Chapter 6, will determine if biological objectives as related to the program are being met, through qualitative and quantitative analysis. Biological objectives are presented in Chapters 1-3 of the updated Master Plan.

4) Define expected project benefits (e.g., preservation of biological diversity, fishery enhancement, water optimization, and habitat protection) (Step 1)?

Expected program benefits are defined in Section 2.2. Specifically, the updated HRPP is intended to result in fishery enhancement through: 1) the establishment of a self sustaining population of spring Chinook salmon in the Hood River subbasin; 2) the establishment of annually sustainable tribal and non-tribal fisheries for winter steelhead and spring chinook salmon; and 3) the reduction of the demographic risk of extirpation of steelhead through continued winter steelhead supplementation and cessation of the hatchery program for summer steelhead. Proposed program changes to the spring Chinook rearing strategies (discussed in detail in Chapter 3) are intended to efficiently utilize water resources for in-basin rearing. Additionally, the loss of the Powerdale Dam adult collection facility provides a unique opportunity to improve management of steelhead stocks in the basin (see 2.2.1). With the installation of trapping facilities in the West Fork and Lower East Fork downstream of the Middle Fork (see Chapter 4), individual stocks can be managed based on the natural migration patterns of the stocks, instead of being managed collectively with the potential for human error during stock differentiation.

Other potential results of the HRPP include those related to ecological and social benefits including the potential for increased nutrients in the ecosystem from salmon carcasses, increased potential to meet NPCC biological objectives in the region, increased potential to meet tribal and sport fisheries objectives in the basin, and increased potential to provide for tribal sustenance. Proposed habitat enhancements (Chapter 5) are expected to benefit instream habitat diversity and riparian function.

5) Describe the implementation strategies (see 2000 Columbia River Basin Fish and Wildlife Program, Basinwide Provisions, Section D.2) as they relate to the current conditions and restoration potential of the habitat for the target species and the life stage of interest (Step 1)?

Two modeling exercises have been used to determine the factors limiting salmonid production within the Hood River Subbasin. In 2003, S. P. Cramer and Associates employed the Unit

Characteristic Method (UCM) to develop carrying capacities for spring Chinook salmon and steelhead as part of a review of the HRPP. In 2004, through the process of developing a subbasin plan for the Hood River, the Ecosystem Diagnostic and Treatment model (EDT) was employed to determine the factors limiting production as well as the effect of various habitat treatments on anadromous salmonid production in the basin.

Key findings from the UCM modeling showed that a lack of pool habitat, combined with low wood complexity, high fines, and high turbidity were key factors limiting freshwater capacity and survival within the Hood River Subbasin. To address the lack of woody debris in the system, which is instrumental in the development of pool habitat and increasing habitat diversity, the CTWSR has proposed habitat treatments that include the placement of LWD in specific reaches of the Hood River as described in Chapter 5 of the Master Plan.

As a result of the habitat analysis conducted in the Program Review (Underwood et al. 2003), co-managers have revisited projected survival, mortality, and natural and hatchery production needs for spring Chinook salmon. The amended production and harvest objectives are based on revised SARs that reflect the actual observed rates, as well as current habitat condition as related to carrying capacity for juvenile rearing and adult spawning potential.

To determine if the updated HRPP is meeting its goals and objectives with regard to restoration of target species, co-managers have developed M&E strategies as presented in Chapter 6. These strategies include the continuation of existing M&E programs in the basin.

The strategy of the spring Chinook salmon M&E program is to:

- Monitor and evaluate the results of the 1993-2010 reintroduction program in meeting program objectives,
- Evaluate the ability of natural produced spring Chinook salmon to sustain themselves during a post-supplementation period, and
- Collect information that will allow for hatchery production to mimic naturally produced salmon life-history characteristics.

The strategy of the Steelhead M&E Program is to:

- Monitor subbasin production of juvenile, smolt, and adult wild summer and winter steelhead to refine estimates of the subbasin’s current and potential carrying capacity in the context of pre- and post- habitat improvement projects,
- Monitor in-basin harvest to evaluate the HRPP's progress in achieving the subbasin's harvest objective (Coccoli 2004), and
- Monitor wild summer steelhead population in response to cessation of supplementation.

Specific biological objectives related to the above strategies are presented in Section 6.2.1, 6.2.2 and 6.2.3.

6) Address the relationship to the habitat strategies (see 2000 Columbia River Basin Fish and Wildlife Program, Basinwide Provisions, Section D.3) (Step 1)?

Actions presented herein are directly connected to on-going HRPP activities intended to aid in the recovery of spring Chinook and winter steelhead, as recommended in local planning documents including the Hood River Subbasin Plan and the Hood River Watershed Habitat Action Plan (see Section 1.3, Table 4). To develop a more habitat-based approach to the HRPP, co-managers propose to incorporate habitat enhancement strategies based on the limiting factors that have been identified for the Hood River Basin. As presented in Section 1.2.5, co-managers have implemented numerous habitat improvement actions as part of the HRPP. The habitat enhancement strategies presented in Chapter 5 have considered the current condition of habitat (though limiting factors analysis conducted by Underwood et al. 2003) as it relates to restoration potential for the migration, spawning and rearing of steelhead and spring Chinook.

As mentioned previously, key findings from the UCM modeling showed that a lack of pool habitat, combined with low wood complexity, high fines, and high turbidity were key factors limiting freshwater capacity and survival within the Hood River Subbasin. Key findings from EDT showed that the five primary limiting factors in the subbasin were channel stability, habitat diversity, flow, sediment load, and key habitat quantity (Coccolli 2004). Although some of these factors contribute to compromised habitat conditions that are beyond the scope of the current Master Plan to address (flow augmentation, for example), the restoration of habitat quantity and diversity are possible through implementation of habitat treatments to restore the biological potential of target anadromous fish species in the basin. To address these limiting factors, the updated Master Plan proposes habitat treatments in specific reaches of the West Fork of the Hood River system. Specifically, the HRPP proposes to increase the amount of in-channel and floodplain large woody debris (LWD) at six locations on the West Fork Hood River, including Lake Branch, Elk and McGee Creeks, which are tributaries to the West Fork Hood River. These projects will treat an estimated 9 miles of stream and 110 acres of habitat, and will be conducted in partnership with the U.S. Forest Service. These projects are described in detail in Chapter 5.

Inherent to the spring Chinook re-introduction component of the HRPP is the use of a stock that is native to the Columbia River Basin for reintroduction efforts. This is consistent with the habitat strategies presented in the Basinwide Provisions. More detail regarding the Deschutes stock of spring Chinook used to establish the Hood River population is presented in Section 2.1.1.

7) Ensure that cost-effective alternate measures are not overlooked and include descriptions of alternatives for resolving the resource problem, including a description of other management activities in the subbasin, province and basin (Step 1)?

The HRPP Master Plan Update evaluated alternative sites and methods for broodstock collection and escapement monitoring following the decommissioning of and subsequent loss of trapping facilities at Powerdale Dam. Initially, three areas were considered for trapping installation in order to address fisheries management requirements of the HRPP: one site each on the West Fork, Middle Fork and East Fork Hood River. A memo describing alternative trapping techniques and facilities is included in Appendix E. The memo provides information regarding exclusion barriers that contributes to the conceptual design and cost-benefit analyses of the trap sites.

With regard to the alternatives considered for in-basin production of spring Chinook salmon in the Hood River, various locations, rearing strategies and water usage techniques were analyzed with respect to benefit to fish, ease of implementation and cost effectiveness. The rearing alternatives, and associated costs, were presented in Chapter 3, specifically, Table 12.

8) Provide the historical and current status of anadromous and resident fish and wildlife in the subbasin most relevant to the proposed project (Step 1)?

A detailed life history and status for each of the anadromous and resident fish species of concern is presented in Appendix C. A summary of wildlife use in the basin is not relevant to this project.

9) Describe current and planned management of anadromous and resident fish and wildlife in the subbasin (Step 1)?

The 1991 Master Plan (O' Toole 1991) and Master Agreement (ODFW and CTWSR 1993) established spring Chinook and steelhead management in the basin (see Chapters 1 and 2). There are four proposed changes to the management plan for stocks in the basin as presented in this Master Plan document. The first change is mandatory if the HRPP is to continue, and that is the development of adult collection facilities to replace those that will be lost when Powerdale Dam is decommissioned. As described in Section 2.2.1 and Chapter 4, two new facilities would be constructed to allow for the continued collection of returning adults, and subsequent management of individuals as part of the HRPP.

The second change relates to rearing strategies for spring Chinook salmon. As a result of the Program Review conducted by Underwood et al. (2003), as well as current knowledge as related to fish health objectives and rearing strategies, spring Chinook juveniles are proposed to be reared in the Hood River Basin as opposed to current rearing practices, which occur in the Deschutes River system. To determine if in-basin rearing is indeed biologically favorable, co-managers are proposing a comparative hatchery release evaluation that compares the size at release, precocial maturation and smolt through adult survival ratios (SARs) of spring Chinook released in the Hood River Basin that are reared at one of three facilities: 1) the Carson National Fish Hatchery in the Wind River drainage (WA); 2) the Round Butte Hatchery / Pelton Ladder in the Deschutes Basin (OR); and 3) the PFF in the Hood River Basin. The results would provide the necessary information for co-managers to determine a long term biologically sound and cost effective spring Chinook salmon production strategy for the Hood River Basin that balances harvest needs with ecological considerations. See Chapters 1 and 4 for more details.

The third change relates to the smolt release guidelines for spring Chinook salmon. Based on the revised smolt-to-adult return rate for spring Chinook (see Section 2.2.2), it has been determined by co-managers that the number of spring Chinook smolts to be released will be increased from 125,000 to 150,000 (refer to Sections 2.2.2 and 3.1 for details).

The final change relates to the cessation of the summer steelhead program (see Section 2.2.3 for details). With the exception of the new adult collection facilities to be installed in West Fork and the Lower East Fork downstream of the Middle Fork, no changes to the currently approved winter steelhead program are proposed under this updated Master Plan; however, in light of recent genetic studies, only wild broodstock will be used, unless the number of wild broodstock is predicted to exceed 25% of the population. The summer steelhead program will be discontinued and the need for the program will be re-evaluated in the future.

Although not discussed in great detail in the Master Plan since it is not part of the HRPP, the last release of the ODFW-managed Skamania steelhead stock into the Hood River occurred in 2007. As currently managed, fish returning to the adult collection facility at the dam are recycled back to the mouth of the river to provide increased harvest opportunities below the dam. Because the dam is to be removed, managers will lose the ability to capture returning adults at the dam and to effectively manage this stock while minimizing impacts on indigenous summer steelhead stocks.

Therefore, the last releases of Skamania steelhead juveniles occurred in 2007 so that the last adults will return to the dam prior to decommissioning.

10) Demonstrate consistency of the proposed project with NOAA Fisheries recovery plans and other fishery management and watershed plans (Step 1)?

Actions presented herein are directly connected to on-going HRPP activities intended to aid in the recovery of spring Chinook and winter steelhead, as recommended in local planning documents including the Hood River Subbasin Plan and the Hood River Watershed Habitat Action Plan (see Section 1.3, Table 4). Natural runs of spring Chinook have been extirpated from the Hood River Basin. The Deschutes River stock utilized as part of the HRPP are not afforded protection under the ESA as the stock is not listed as an artificial population that is considered part of the Lower Columbia Chinook ESU. As such, spring Chinook in the Hood River basin are not currently part of NOAA recovery plans. Steelhead stocks in the basin, and their subsequent recovery objectives, are consistent with management plans in the watershed. Production associated with the HRPP will follow HSRG guidelines.

11) Describe the status of the comprehensive environmental assessment (Step 1 and 2)?

An Environmental Impact Statement (EIS) for the HRPP, which authorized BPA to fund salmon and steelhead enhancement activities in the Hood River Basin, was completed in 1996 (BPA 1996). The EIS specified seven years of M&E (1996- 2002) after program implementation to determine if program actions needed modification to meet program objectives. The M&E program was conducted for the prescribed period, and is currently on-going. The updated Master Plan would continue M&E activities, as described in Chapter 6. The EIS also called for a program review after 2002, which was completed by Underwood et al. in 2003.

The updated Master Plan will undergo analysis under NEPA, and other applicable federal, state, and local regulations, during subsequent phases in the review process. Specifically, an environmental assessment (under NEPA) of the primary collection and rearing alternatives will be developed during Step 2 of the 3-Step review process.

12) Describe the monitoring and evaluation plan (see 2000 Columbia River Basin Fish and Wildlife Program, Basinwide Provisions, Section D.9) (Step 1, 2 and 3)?

A conceptual monitoring and evaluation (M&E) plan has been prepared specific to the HRPP's target species (See Section 6.2). The approach is intended to assist co-managers in the determination of whether the updated HRPP is successful in the re-introduction of spring Chinook salmon in the Hood River basin, and to monitor returns of steelhead to the subbasin. Success of the HRPP will be gauged primarily by analysis of the changes in abundance and distribution of spring Chinook salmon spawning aggregates.

Information gathering strategies proposed to monitor the spring Chinook salmon component of this program may be adaptively managed to optimize data analysis while minimizing ecological impacts associated with M&E strategies. The conceptual M&E plan provides a framework upon which a detailed M&E plan can be based. The conceptual plan is presented in Chapter 6 of the Master Plan.

An existing M&E plan for steelhead has been developed and implemented by ODFW since program inception. A simplified version of this plan is included in the updated Master Plan (see Chapter 6).

13) Describe and provide specific items and cost estimates for ten fiscal years for planning and design (i.e. conceptual, preliminary and final), construction, operation and maintenance and monitoring and evaluation (Step 1, 2 and 3)?

Proposed facility upgrades at PFF and costs associated with development of the Moving Falls facility and the proposed two adult collection facilities are described in Chapters 3 and 4 (see Tables 12, 15 and 16). See Chapter 7 for cost details.

B. Artificial Production Initiatives

Does the Master Plan:

1) Address the relation and link to the artificial production policies and strategies (see 2000 Columbia River Basin Fish and Wildlife Program, Basinwide Provisions, Section D.4 and Technical Appendix) (Step 1)?

The APR standards:

- **The purpose and use of artificial production must be considered in the context of the ecological environment in which it will be used. (See A.1 and A.6)**

  The HRPP is an existing supplementation program funded by BPA since the early 1990s. The rationale for the HRPP's primary goals of rebuilding self-sustaining populations of summer and winter steelhead and re-establishing a self sustaining population of wild spring Chinook in the subbasin, has been described in a multitude of documents, including the HRPP Review. See Chapters 1 and 2, which discuss the purpose and need of the HRPP with respect to supplementation and harvest needs.

- **Artificial production must be implemented within an experimental, adaptive management design that includes an aggressive program to evaluate the risks and benefits and address scientific uncertainties. (See A.12)**

  HRPP co-managers recognize the risk and uncertainty associated with artificial production. As such, program proponents have approached supplementation efforts experimentally in relationship to habitat and management of stocks. Adaptive management has been infused into the HRPP since its inception. Adjustments to the spring Chinook rearing strategies, target hatchery smolt production guidelines and harvest objectives have resulted from on-going program review.

  As the Hood River system is dynamic in nature, so must be the HRPP. Flexibility is inherent in the program to provide the best opportunity for success in relation to biological objectives. Given this, and new studies regarding the potential harm to wild summer steelhead populations due to reduced reproductive fitness of second generation hatchery-reared fish and the potential for interbreeding with wild fish, the summer steelhead program will be discontinued. The need for the program in the future will be revisited through consultation with NOAA Fisheries.

  Monitoring and evaluation plans have been modified to address program changes (see Chapter 6), and on-going program review will consider if new techniques or strategies are necessary to keep moving toward establishment of wild, self-sustaining populations of Chinook and maintenance of viable populations of steelhead in the basin.

- **Hatcheries must be operated in a manner that recognizes that they exist within ecological systems whose behavior is constrained by larger-scale basin, regional and global factors. (See A.1)**

  This principle is particularly relevant in the Hood River Basin in consideration of the dynamic nature of the system. As described above, monitoring and evaluation plans have been modified to address program changes (see Chapter 6), and on-going program review will consider if new techniques or strategies are necessary to keep moving toward establishment of wild, self-sustaining populations of Chinook and maintenance of viable populations of steelhead in the basin.

- **A diversity of life history types and species needs to be maintained in order to sustain a system of populations in the face of environmental variation. (See A.1)**

  The HRPP currently traps target fish over the entire run, ensuring that all life history types in relation to spawn timing are represented in the broodstock. The new adult collection facilities are intended to capture a full complement of adult fish from Hood River reaches to which they naturally escape.

Under the updated HRPP as presented in this Master Plan, fish would be released at a size equivalent to their natural counterparts. For spring Chinook, this would be achieved by implementation of a comparative release study to test if rearing hatchery fish on Hood River surface water will produce lower jacking/mini-jacking rates and higher SARs when compared to out-of-basin rearing. Rearing on cooler river water in the Hood River Subbasin and the Wind River at the Carson National Fish Hatchery will better mimic the natural temperatures and conditions within which wild Hood River fish develop. See Chapter 3 for more details on production profiles.

The winter steelhead production component currently collects wild brood fish to infuse genetic variability and introduce new complexes with the intention of establishing an integrated hatchery stock that is capable of sustaining itself in the face of environmental variation.

- **Naturally selected populations should provide the model for successful artificially reared populations, in regard to population structure, mating protocol, behavior, growth, morphology, nutrient cycling, and other biological characteristics.**

  Refer to Chapter 3, Section 3.2, for details on spawning protocols, and juvenile rearing and release strategies. Spawning protocols will be consistent with the Hatchery Review Scientific Group recommendations for integrated facilities, and rearing protocols will reflect the best husbandry practices as recommended by the HSRG and the IHOT.

- **The entities authorizing or managing an artificial production facility or program should explicitly identify whether the artificial propagation product is intended for the purpose of augmentation, mitigation, restoration, preservation, research, or some combination of those purposes for each population of fish addressed. (See A.3)**

  As stated throughout Chapter 2 (Section 2.2), the primary benefit expected from proposed program changes is to improve upon and continue the goals and objectives of the program as presented in the 1991 HRPP Master Plan, including the re-establishment of a wild population (integrated program) of Chinook in the basin, the establishment of an adequate tribal and non-tribal fishery and the reduction of the demographic risk of extirpation of winter steelhead through supplementation. In consideration of recent science, the best way to reduce the risk of extirpation of summer steelhead is through the cessation of the current hatchery program.

- **Decisions on the use of the artificial production tool need to be made in the context of deciding on fish and wildlife goals, objectives and strategies at the subbasin and province levels. (See A.2)**

  The HRPP is an existing production program and modifications to that program have considered the biological objectives for each stock included in the program (see Tables 1 and 9). The HRPP is supported by subbasin planners and modifications to the program, as proposed in the Master Plan, are anticipated to increase the success of the Chinook reintroduction efforts. The 1990 Hood River Subbasin Plan argued that BPA had an obligation to restore natural runs of salmon and steelhead through the use of supplementation to meet the Northwest Power and Conservation Council's salmon and steelhead recovery goal. Through both the master planning process and the subbasin planning process, the HRPP established the production guidelines identified in the 1991 Master Plan. See Chapter 1, specifically Section 1.3 for details on how the HRPP considers objectives and strategies of programs in the region.

Tribal harvest objectives for Hood River spring Chinook salmon are to restore consistent subsistence and ceremonial harvest opportunities for Warm Springs Tribal members within their ceded lands throughout variable annual adult returns. Currently the Deschutes River provides the only reliable tributary harvest opportunity for the tribes within their ceded areas. The tribes harvested fish within the Hood River basin for subsistence purposes prior to their relocation to reservations. While exact numbers of Chinook salmon historically harvested is unknown it was likely much greater than what is currently available.

Several tribal families reside in the Hood River Valley and Columbia Gorge and are welcoming the return of the salmon. Many of these families have lived within the area for generations. While salmon remains an essential component of tribal culture the ability of recent generations of tribal members to harvest salmon in the Hood River has been severely restricted through the loss of harvestable salmon runs during most of the last thirty years. The lack of harvest opportunities within the basin has force fishers to harvest salmon at other locations. This has resulted in a loss of local fishery knowledge and access to traditional Hood River fishing sites.

Re-establishing tribal harvest in the Hood River, a major goal of the HRPP, has been hindered by inconsistent annual harvest opportunities. The tribal fishery in the Hood River is centered around harvest at Punchbowl Falls. Harvest has only been allowed in four years during implementation of the HRPP. The primary intent of the increased smolt release, in combination with the increased smolt survival expected from the decommissioning of Powerdale Dam and other habitat restoration efforts, is to provide a consistent annual fishery for tribal members. Tribal effort will increase as word spreads of the harvest opportunities in the Hood River. Salmon not harvested in the tribal and sport fisheries and in surplus of broodstock / supplementation needs will be fully utilized by the tribes upon their removal from the weir. Those fish will be delivered to the Warm Springs Reservation and distributed to tribal members who are elderly or unable to fish themselves. Currently all surplus fish from the Deschutes fishery are distributed to the tribes. However, fish available for distribution is insufficient of tribal needs. In addition to in-river harvest of program fish, the HRPP will contribute to mainstem Columbia ceremonial and commercial fisheries.

- **Appropriate risk management needs to be maintained in using the tool of artificial propagation.**

  The HRPP will follow Hatchery Science Review Group integrated program guidelines (HSRG et al. 2004) with regard to spawning, rearing and release strategies. See Chapter 5, Section 3.2 for details. If in-basin rearing at the Moving Falls facility is to occur, the facility would be gravity fed; therefore, the risk associated with brief power outages would be minimized. The PFF can also serve as a back up for rearing in emergency situations, as necessary. And rearing out of basin at comparative release sites is a possibility.

Due to the portable nature of the Lower East Fork floating weir, if conditions become unfavorable for adult collection there, collection can occur in the East or Middle forks as appropriate.

- **Production for harvest is a legitimate management objective of artificial production, but to minimize adverse impacts on natural populations associated with harvest management of artificially produced populations, harvest rates and practices must be dictated by the requirements to sustain naturally spawning populations. (see B.3)**

  Impacts of the current HRPP on natural production in the Hood River Basin were considered in the original 1991 Master Plan, and are the subject of on-going M&E evaluations. The proposed modifications to the program would not result in changes to winter steelhead production in the basin, but summer steelhead hatchery production will be discontinued. M&E programs would continue to evaluate impacts of the HRPP on natural steelhead populations. The revised M&E plan, as presented in Chapter 6, would continue to evaluate the impact of the production program on re-established wild populations through a comparison of life history traits and escapement, and the program would be adaptively managed to determine when and if supplementation should be discontinued based on wild returns to the system. Additionally, the proposed weirs would allow full separation of wild fish from hatchery fish throughout a large part of the Hood River Basin.

- **Federal and other legal mandates and obligations for fish protection, mitigation, and enhancement must be fully addressed. (See A.10)**

  All proposed adjustments to the HRPP will undergo applicable environmental reviews as required by federal, state and local regulations. These will occur during Steps 2 and 3 of the 3-Step Review process. See Section 1.3 for more information.

2) Provide a completed Hatchery and Genetic Management Plan (HGMP) for the target population (s) (Step 1)?

HGMPs were completed for the HRPP as part of the original Master Plan (1991) and Master Agreement (1994). These documents have been updated to reflect the currently proposed program. Revised HGMPs are attached to the Master Plan as Appendices I and J.

3) Describe the harvest plan (see 2000 Columbia River Basin Fish and Wildlife Program, Basinwide Provisions, Section D.5) (Step 1)?

Harvest management is consistent with guidelines established for broodstock collection (see Table 1, Section 1.2.4, Table 3, and Sections 2.3 and 2.4). Harvest in the basin is limited to hatchery fish and all hatchery fish are marked and coded-wire-tagged. Monitoring of creel surveys is the basis by which harvest objectives are set in consideration of broodstock collection needs. Sufficient M&E programs are necessary to monitor harvest to ensure that enough hatchery fish are available for broodstock. The spring Chinook and steelhead M&E program (Chapter 6) presented in the updated Master Plan proposes a continuation of the

HRPP's existing M&E project, and has been designed to provide the needed flexibility required to address any future data gathering needs relative to harvest as identified by the co-managers.

4) Provide a conceptual design of the proposed facilities, including an assessment of the availability and utility of existing facilities (Step 1)?

Conceptual designs for the proposed new rearing facility at Moving Falls, as well as the two new adult collection facilities, are presented in Chapters 3 and 4, respectively. An assessment of the availability and utility of using existing facilities is presented in Chapter 3.

APPENDIX C: SUBBASIN ATTRIBUTES AND LIFE HISTORY OF SENSITIVE HOOD RIVER SALMONIDS

C.1 Hood River Subbasin Attributes and Effects on Salmonids

The Hood River is contained within the Hood River Subbasin, which covers approximately 216,957 acres (Figure 1). The mainstem Hood River is approximately 14.6 miles long with six primary tributaries and passes through the City of Hood River. The mainstem stream flow is primarily derived from the East, Middle, and West forks. The system includes 695 stream miles. Coccoli (2000) reported that 108 miles of this were accessible to anadromous fish (Coccoli 2000), however, the formation of a naturally occurring barrier on the Middle Fork during the 2006 flood has removed all but about one mile of that fork as anadromous habitat. Steelhead appear to be passing the lower falls and accessing Tony Creek, but the second falls upstream appears impassable (R. French, ODFW, pers. comm., 12/28/07). The resulting river length that is accessible to anadromous fish is approximately 99 miles.

The Hood River flows northeasterly into the Columbia River at RM 168, twenty-two miles upstream from Bonneville Dam. The headwaters of the Hood River are derived from glaciers on the north and east slopes of Mt. Hood. Because the Hood River is glacially-driven, it is highly influenced by glacial recession and rain-on-snow events, causing a dynamic hydrograph and high turbidity. This system frequently experiences catastrophic landslides and dam-break floods originating on the moraines and steep slopes of Mt. Hood.

The West Fork of the Hood River is 14.6 miles long, entering the mainstem at RM 12. The West Fork Subbasin is on the northern slope of Mount Hood, reaching the crest of the Cascade Range. This fork is the least affected by glacial runoff and contributes approximately 50% of the flow to the mainstem.

The Middle Fork of the Hood River is 10.2 miles long. The confluence of the Middle and East forks form the mainstem, which begins at RM 14.6. The Middle Fork subbasin lies on the northeast slope of Mt. Hood and is bordered by West and East Fork drainages. The Middle Fork is strongly influenced by glacial recession in Elliot and Coe Creeks causing abundant silt and sand delivery. The Middle Fork and its 10 tributaries contribute roughly 24% of the annual mainstem flow.

The East Fork is the longest tributary, stretching 28.8 miles, to the Clark, Newton and Polallie glaciers. This fork is strongly influenced by glacial recession and rain-on-snow events. The East Fork and its associated 27 tributaries contribute approximately 26% of the annual mainstem flow.

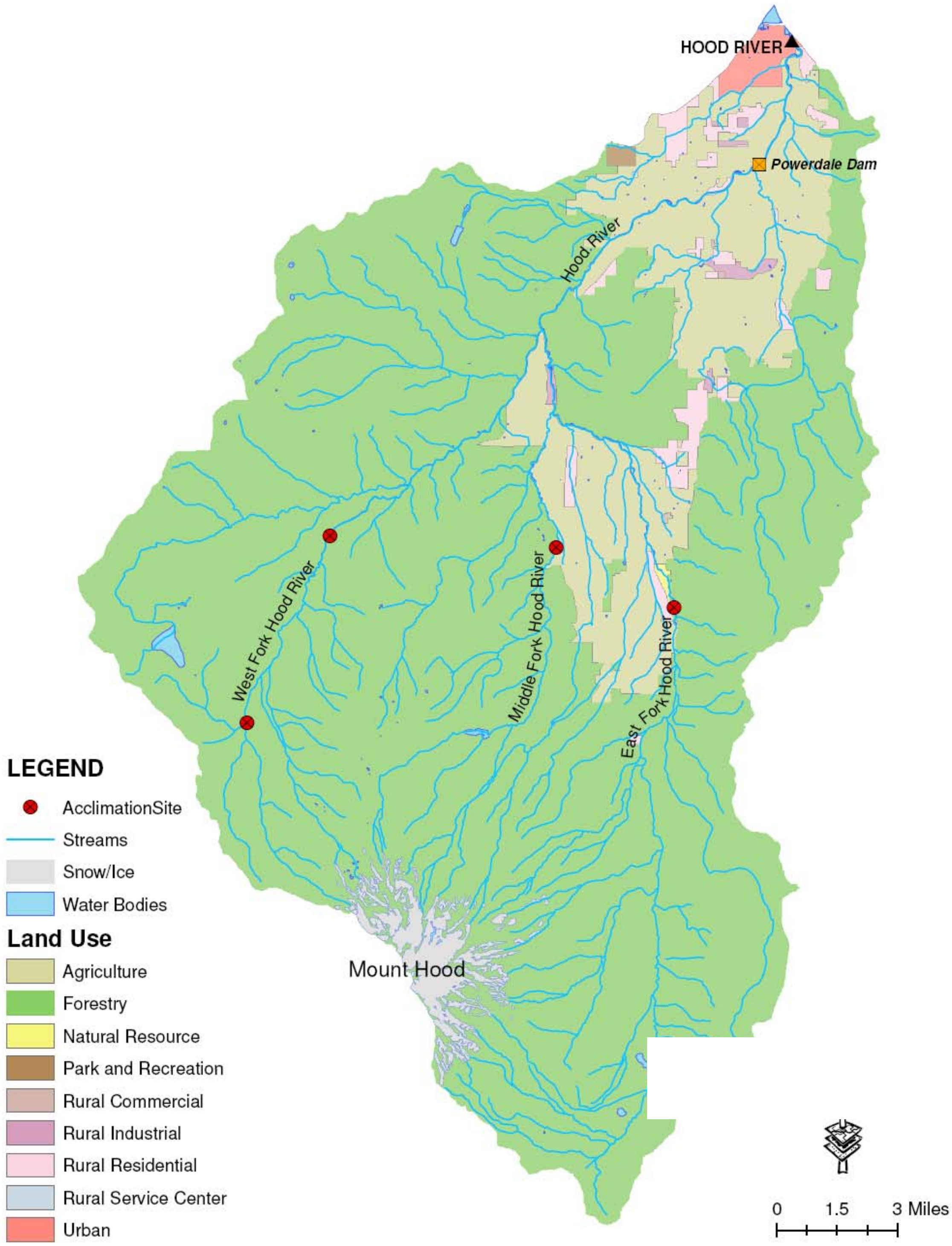


Figure 1: Vegetation Map of the Hood River Basin

C.1.1 Land Use

The majority of land within the Hood River Subbasin is under forest management by the U.S. Forest Service (USFS), Hood River County, and Longview Fibre. Irrigated agriculture in the form of orchards and pasture lands are also common uses within the subbasin (Figure 2).

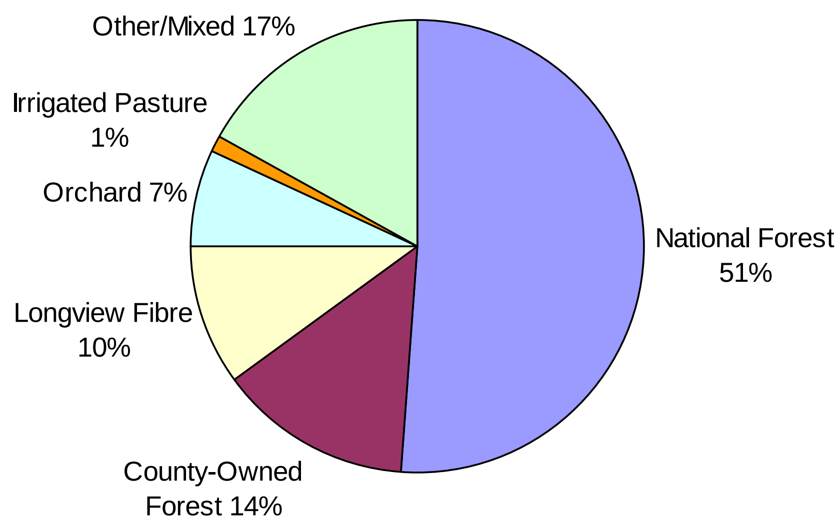


Figure 2: General Land Use in the Hood River Watershed by Proportion (Reproduced from Coccoli 2001)

C.1.2 Climate

The Hood River Subbasin is located within the Oregon high desert, coastal marine, and mountain climate regimes. Annual rainfall within the Hood River Subbasin is variable, decreasing north and east of Mount Hood with decreased elevation. On average, the West Fork receives the greatest amount of precipitation followed by the Middle Fork and East Fork (USFS 1996a and 1996b). The spring and fall months are the most variable climatic periods with frequent rain-on-snow events causing floods and associated debris torrents. The climate during the last ten years has exhibited extreme precipitation in excess of 135% of average snow pack and rainfall. These conditions have significant effects on the steam flow of the Hood River as evidenced in the following section.

C.1.3 Hydrology

A variety of hydrologic factors influence fish production and distribution in the basin. These factors include stream flow, water temperature, turbidity, sediment, and hydro-modification, including hydraulic and hydrogeomorphic changes due to the construction of dams and on-going irrigation withdrawals.

Stream Flow

Rainfall, snow pack, and air temperature are major predictors of stream flow. From 1991-2001, Hood River annual stream flow varied from below median (59-79% of the 34 year average for water years 1967-2001) to significantly above median (102 -177% of the 34 year average). Above-average flow years have had dramatic effects on the geomorphology of the river by resorting streambed substrate materials and displacing woody debris downstream. In 2006, a debris torrent in the Middle fork created two impassible falls that restricted anadromous access to the first river mile. Fish survival during extreme flow events is typically expected to drop because of fish being flushed out of the river (Giannico and Healey 1998, and Tschaplinski and Hartman 1983). Following the November 2006 flood, several thousand fish were observed in the fish ladder at Powerdale Dam, and this occurrence has been observed during other large glacial events (R. French, ODFW, pers. comm., 11/21/07). However, these events do not typically occur basin-wide. For example, during 2006, the Middle Fork was subjected to extreme flows and resulting effects, while the West Fork was relatively unscathed, with very good Chinook overwinter survival (C. Brun, CTWSR, pers. comm., 11/2/07).

Average daily stream flow is a coarse predictor of water passing though the river. It does not, however, indicate whether the flow is distributed evenly over the year or whether a majority of the flow rushed through the river in a couple of months (i.e. the “shape” of the annual hydrograph). The Hood River is a very dynamic system that typically experiences rain-on-snow events. To illustrate this fact, Figure 3 displays the daily average stream flow during a 15 year period (1996-2006), as well as the 15 year averages. Note the extreme and rapid stream flow peaks between November and May of each year; such peaks were likely caused by characteristic rain-on-snow events.

Stream flow data for the forks is limited. The West Fork had a USGS gauge station in operation from 1932 to 1999 at Dee approximately 0.25 miles upstream from the mouth. No long term data existed for the East and Middle forks resulting in ODFW installing gauge staffs in the East Fork in 1994 and in the Middle Fork in 1996. ODFW obtained daily staff readings from March through November (Olsen 2000). Based on a combination of USGS and ODFW data, we estimated the contribution of stream flow by each fork to better understand this system. On a monthly basis, the percent contribution did change slightly among forks. However, the West Fork contributed the greatest percentage of flow (43%), followed by the East (41%) and Middle (16%) forks. The forks appeared to follow similar peak stream flow; however, the East and Middle forks had a greater likelihood of providing catastrophic flood events caused by dam-break floods during fall, associated with glacier recession and rain-on-snow events. Catastrophic events occurred on September 30, 2000 on the East Fork (Newton Creek), and again in the Middle Fork (Elliot Creek) during November 2006.

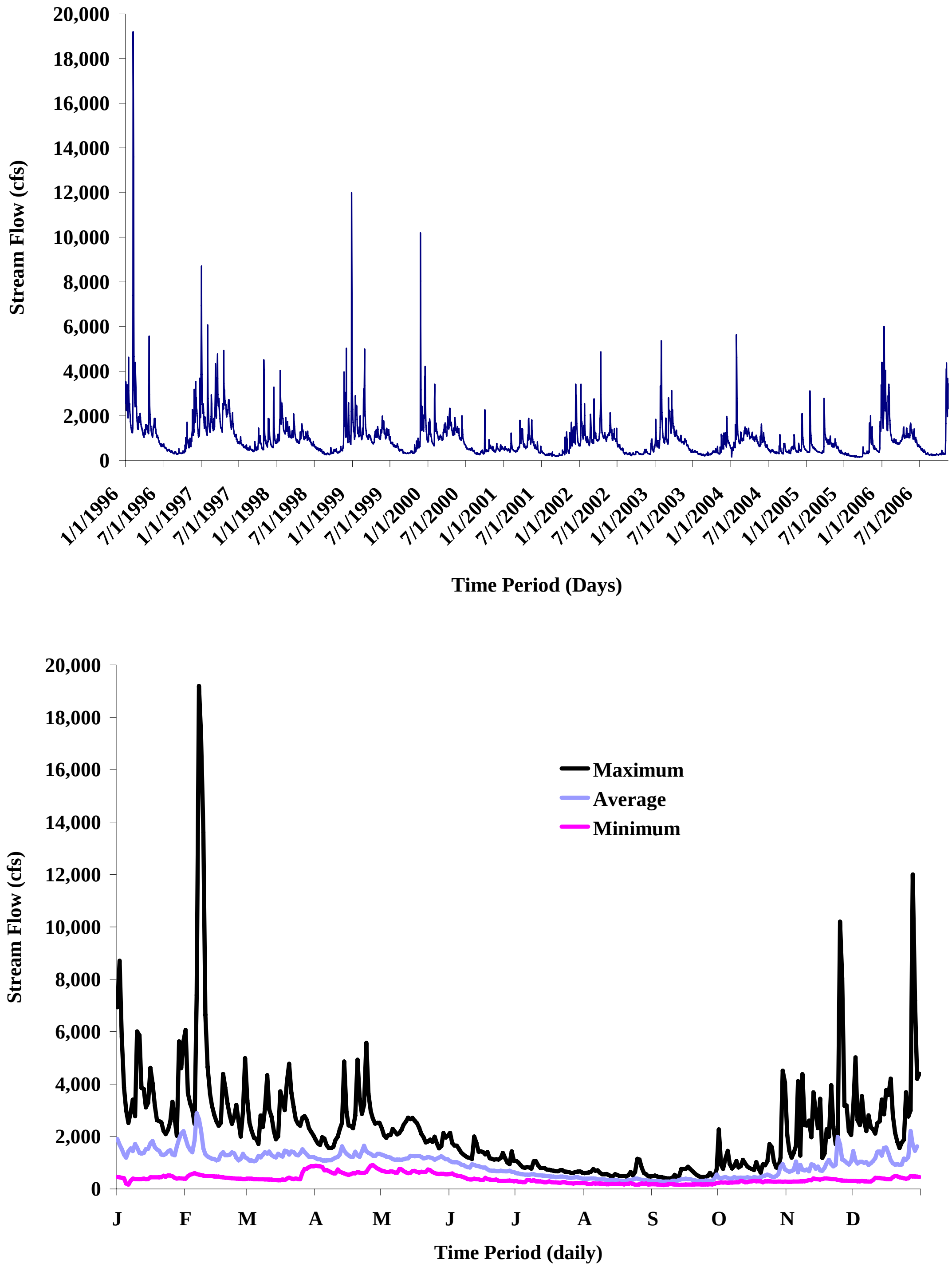


Figure 3: Daily Mean, Minimum and Maximum Average Stream Flow during the Period 1996-2006 in the Mainstem Hood River at Tucker Bridge (RM 6.1, USGS Station 14120000), First graph displays the daily average stream flow, while second displays the 15-year averages

Water Temperature

In 1998, the Hood River was included on the Clean Water Act 303(d) list for violating temperature criteria based on the presence of particular fish species that reside in the basin (i.e. bull trout). Maximum water temperature standards were set at 64°F 7-day maximum during juvenile fish rearing and 55°F for 7-days during spawning of anadromous salmonids in a majority of the subbasin. Additionally, streams supporting bull trout are not to exceed 50°F, which includes selected tributaries of the Middle and West forks. Average temperatures in the Hood River Basin typically range from 3 to 16°C (37 to 61°F). The East Fork tributary registers the warmest water temperatures throughout a majority of the year followed by the mainstem, Middle and West forks (Underwood et al. 2003). The high temperatures in the East Fork are likely due to reduced summer flows due to irrigation withdrawals in the lower tributary.

The temperature regime in the basin directly influences the development, growth, and survival of salmonids in the basin. According to Beacham and Murray (1990), salmonids must spawn sufficiently late in the year to avoid exposing eggs to waters approaching a maximum daily temperature of 14°C (57°F), the point at which thermal tolerance is reached and mortality may result. Temperature data from the Hood River Basin indicates that spring Chinook eggs deposited in September in the lower reaches of the West Fork may be subjected to temperatures above the 14°C (57°F) threshold, resulting in reduced survival (Underwood et al. 2003).

Temperature has a direct influence on the growth rate of juvenile salmonids. Bisson and Davis (1976) found that juvenile Chinook grew best at temperatures from 9-15°C (48-59°F), while data from the Rogue River indicated that steelhead grew best at temperatures of 11-15°C (52-59°F) (Fustish et al. 1989). The mainstem Hood River is above 11°C (52°F) from early June through mid-September, and suitable for growth of juvenile steelhead. However, temperature data indicates growth opportunities may be limited for juveniles in upper spawning and rearing areas of the Hood River forks. Cool temperatures may be limiting growth opportunities for juvenile spring Chinook and steelhead in the West Fork. Temperatures in the primary spring Chinook spawning reaches of the West Fork only remain above 9°C (48°F) from early July to late September, allowing roughly 3 months of optimal growth (Underwood et al. 2003); however, such summer temperatures are typical of many Chinook-bearing streams in the Pacific Northwest. In the lower East Fork, temperatures are in the optimal growth range from mid-June to mid-September, but above RM 13, temperatures were cooler, likely reducing growth above that altitude. At approximately RM 3.5 of the Middle Fork, average 7-day temperatures rarely exceed 10°C (50°F), and tributaries provide suitable temperatures in the summer for juvenile growth and development.

Turbidity and Total Suspended Solids

Hood River reaches lacking glacial influence are least turbid in the summer and most turbid during months of major runoff, typically occurring during fall and spring. However, most streams in the Hood River Basin are glacially-driven, and are most turbid during the summer months due to glacial melting, and least turbid in the winter. Melting glaciers deposit fine ground-up sand and stone called "glacial flour" into the headwaters of the forks during summer, increasing turbidity and suspended solids. Of the Hood River forks, the West Fork is least influenced by glacial melting, while the East and Middle forks are most heavily influenced. Whether or not a stream is glacially influenced affects the species that use the system.

High concentrations of suspended solids may have both positive and negative effects on salmonids, including impaired growth, distribution, and predator avoidance, among many others (Underwood et al. 2003). However, the concentrations of suspended solids found in the Hood River Basin are much lower than river systems where harmful physiological effects were observed in many cited studies (Underwood et al. 2003). Based on a literature review of suspended sediment and the effect on salmonids, Underwood et al. (2003) determined that the concentrations of suspended solids (generally below 50 mg/L) are not likely to negatively affect steelhead and spring Chinook stocks with respect to physiology. Bisson and Bilby (1982) indicate that avoidance in acclimated fish begins at 100 NTU (275-600mg/L).

Although suspended solids and turbidity in the Hood River Basin are not likely to affect juvenile and adult salmonid physiology, turbidity does result in a reduction of primary production. Bash et al. (2001) suggest that over a period of 3 or 4 months even a low level of sediment could smother incubating eggs. Studies (Lloyd et al. 1987; Wagener and LaPerriere 1985) suggest that macroinvertebrates are strongly influenced by total suspended solids and that macroinvertebrate and fish production are directly related to primary production. Decreases in primary production subsequently result in decreased macroinvertebrate (fish food) abundance and decreased macroinvertebrate production results in limited fish growth and survival. In summary, the greater the turbidity, the less hospitable the environment for fish populations (Figure 4).

Sediment

It is known that excessive amounts of fine sediment can negatively affect salmonids by reducing survival of eggs and rearing juveniles. Bjornn and Raiser (1991) present data showing that survival of Chinook and steelhead embryos begins declining as the percentage of fines (<6.35mm) in redds increases above 25%. The presence of fines impairs delivery of oxygen to the eggs. Kondolf (2000) found that fines <1 mm diameter may suffocate eggs by impairing flow over the eggs, and should be less than 12-14% of particles in redds. Both Kondolf (2000) and Bjornn and Raiser (1991) found that emergence can be inhibited by high concentrations of fines in redds. Excess fines can reduce parr rearing potential as well. Newly emerged fry use interstial spaces in the cobble substrate as cover from velocity. Density of juvenile steelhead and Chinook in summer and winter was reduced by more than half when enough sand was added to fully embed the large cobble substrate in an experimental stream (Bjornn et al. 1977). Thompson and Lee (2000) found that probability of moderate to high densities of steelhead parr in Idaho streams decreased as the percentage of the watershed with unconsolidated lithology increased. They deduced that this type of lithology was prone to sedimentation and reduced the survival of parr.

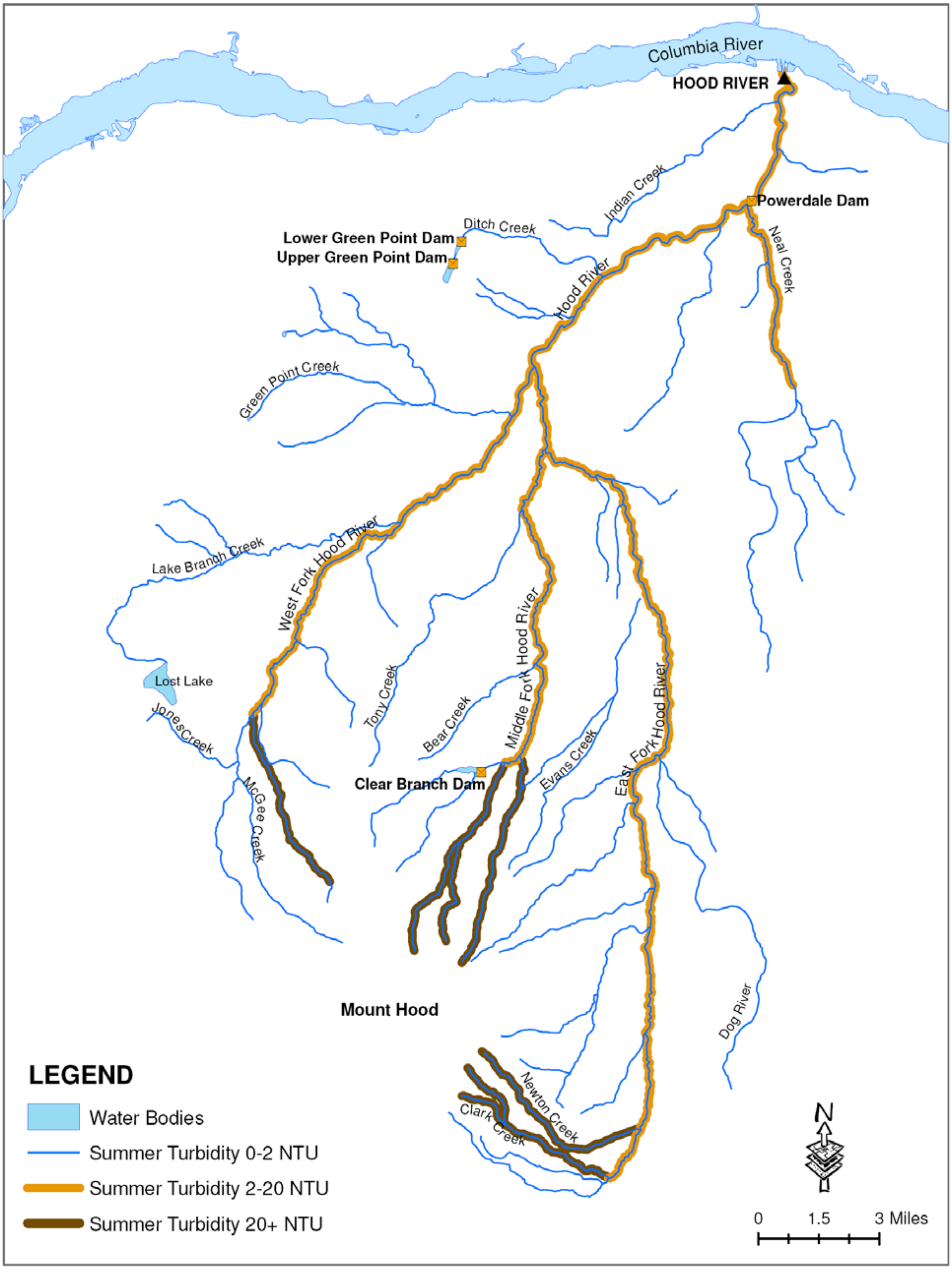


Figure 4: Map of the Hood River Indicating Turbidity Levels by Stream Reach

According to Underwood et al. (2003), low flow habitat surveys conducted by ODFW indicated that the percent of sand and silt in riffles ranges from 41-46% in reaches of the lower East Fork and from 6-23% in a Chinook spawning reach of the West Fork, although the average was less than 15% fines. In a literature review conducted by Cramer (2001), it was apparent that fines in excess of 15% in riffles had a negative effect on the potential rearing capacity of a given reach. In the East Fork Hood River below Dog River, fines are exceedingly high at nearly 40%. Fines were also high at 25% of the substrate in riffles in the turbid Middle Fork. The high presence of fines in much of the Hood River is likely detrimental to the salmon and steelhead production potential.

Gradient

Increased gradient is associated with increased scouring, which reduces the likelihood of successful spawning (Montgomery et al. 1999). Montgomery et al. (1999) found that spawning in steep gradient reaches (greater than 3%) would only be successful when spawning occurs after the period of peak flow. Since peak flow in the Hood River Basin generally occurs in the winter and early spring, steelhead are more likely to be successful than spring Chinook in steep reaches, because they spawn in the spring whereas spring Chinook spawn in the fall.

The distribution of gradient throughout the Hood River Basin provided insight into the distribution of spring Chinook and steelhead. Gradient in the Hood River Basin was generally high at 3% or greater with a range of 1-7%. Spring Chinook production occurs almost entirely in the West Fork where gradient is only 1% in the most used reach. With the exception of the mainstem Hood River, and the East Fork from the confluence with the Middle Fork to the Dog River, gradient throughout the rest of the basin was high at 3% or greater. High gradient results in fast water habitat types dominated by boulder substrate. Steelhead have an affinity for pocket water associated with boulder habitat whereas spring Chinook have a lower preference for this type of habitat (Bjornn and Raiser 1991). Thus, steelhead make greater use of high gradient habitat than do spring Chinook.

Stream Morphology

Gradient and channel morphology play an important role in determining the physical habitat of a reach. Spring Chinook spawners prefer reaches with high pool composition over reaches with low pool composition (Montgomery et al. 1999). Pools not only provide holding areas throughout the summer for spring Chinook, but they also create tailouts which are favored spawning locations (Lambert et al. 2001). Juvenile rearing densities of both spring Chinook and steelhead parr were highest in pools of all main channel units (Bumgarner et al. 1994; Bumgarner et al. 1995; Mendel et al. 1993; Bjornn and Reiser 1991).

Within the Hood River Basin, the West Fork has the highest pool composition and deepest pools among the main tributaries. The presence of numerous deep pools in the West Fork is ideal summer holding habitat for summer steelhead and spring Chinook. A lack of deep pools in the East and Middle forks may limit use by summer steelhead and spring Chinook. The East and Middle forks are characterized by an abundance of rapid and riffle habitat. Though the East and Middle forks are not as conducive for summer holding, winter steelhead are able to spawn successfully in these two forks. Additionally, the increased amount of boulder rapids in these reaches is ideal for feeding stations preferred by rearing juvenile steelhead.

Hydro Modifications

Hydroelectric Dams

Four dams occur within the Hood River Subbasin including the Powerdale Dam, Clear Branch Dam and Upper and Lower Green Point dams. The Powerdale Dam, proposed for decommissioning by 2010, is located at RM 4.5 of the mainstem Hood River. Water diverted at this dam is returned to the Hood River at RM 1.5, resulting in a 3 mile diversion reach. Powerdale Dam has adversely affected salmonid populations in three ways: 1) it may have contributed to delays, however slight, to adult anadromous fish migrating upstream, 2) it has diverted smolts into a bypass channel and through an inefficiently screened turbine, and 3) it removed water (~500 cfs) from 3 miles of river. Diversions of 500 cfs at Powerdale Dam remove 39-81% of average monthly discharge in the lower Hood River (Underwood et al. 2003).

Clear Branch Dam is located in the upper headwaters of the Middle Fork of the Hood River approximately one mile upstream of the confluence with Coe Branch. This dam limited downstream passage, and with no upstream passage removed a substantial amount of spring Chinook spawning and rearing habitat. The dam may also have affected fish survival downstream due to flow and temperature alterations. The Upper and Lower Green Point dams are located in the upper headwaters of Green Point Creek. These dams are upstream of known anadromous fish distributions and are therefore believed to have minor effects on anadromous fish.

Irrigation Withdrawals

Five irrigation districts operate in Hood River holding a total of 588 cfs in water rights (HRWG 2001). According to Underwood et al. (2003), there are three primary water withdrawal sites within anadromous fish migration and rearing corridors of the Hood River forks and mainstem. At RM 6.6 of the East Fork, the East Fork Irrigation District operates an irrigation withdrawal and sand trap with a 120 cfs water right. On the West Fork, Dee Irrigation District withdraws irrigation water at RM 6.1 with a 12.7 cfs water right. The Farmers Irrigation District withdraws water at RM 10 of the Hood River mainstem, holding a water right of up to 176 cfs An additional 233 cfs of water rights are allocated to irrigation districts for water withdrawals from tributaries of the forks and the mainstem Hood River. Municipalities hold 40 cfs and industries hold approximately 60 cfs of water rights in Hood River tributaries.

C.2 Life History and Population Biology of Sensitive Salmonids in the Hood River

Although other significant fish species also inhabit the Hood River, including fall Chinook, coho, pacific lamprey, sea-run cutthroat trout, bull trout, coastal cutthroat trout and rainbow trout, the HRPP focuses on spring Chinook and winter and summer steelhead owing to the fact that BPA has focused funding on these fishes under past HRPP practices, though summer steelhead production will be discontinued, with the last smolt release in 2010.

C.2.1 Chinook Salmon

Status of Chinook Salmon in the Hood River Basin

Both spring and fall-run Chinook occur in the Hood River. Differences in life history characteristics between the two stocks include adult return timing, median time of spawning, spatial distribution, smolt age, age at return, and relative size at return. According to ODFW (2007), both fall and spring Chinook in the Hood River are at very high risk of extinction.

Fall Chinook

According to the Oregon Lower Columbia Recovery Plan (ODFW 2007), the Hood River fall Chinook population is classified in the "extirpated or nearly so" persistence category. Little is known about its historical abundance. Fall Chinook currently present in the Hood River are believed to be hatchery strays and the progeny of hatchery strays as the genetic makeup of fall Chinook is likely very similar to Spring Creek National Fish Hatchery. Recent DNA data from USFWS indicates that a remnant population of fish may remain, which are different than Spring Creek or other fall Chinook (R. French, ODFW, pers. comm.). This stock faces a high risk of extirpation because of stock origin and because its distribution is limited to the mainstem Hood River, which experiences high glacial sediment loads.

Abundance of fall Chinook in the Hood River is currently believed to be very low (Coccoli 2004). For the period from 1992 -2003 the annual return of fall Chinook to Powerdale Dam averaged 26 fish, with a range from 6 to 70 (Coccoli 2004). The majority of the fall Chinook spawn in the lower Hood River mainstem below Powerdale Dam and in Neal Creek, although spawning also occurs in the lower East Fork (BPA 1996) and West Fork Hood River (Coccoli 2004). Fall Chinook enter from early July through October, and spawn in late September through early November and juveniles appear to outmigrate as subyearlings (Underwood et al. 2003).

Spring Chinook

The indigenous spring Chinook stock was extirpated by the early 1970s (CTWSR and ODFW 1991). Several probable causes contributed to their demise including: 1) lack of, or inefficient juvenile fish protection at irrigation canals (Farmers Irrigation Diversion, Dee Irrigation Diversion, PacifiCorp diversion at Powerdale Dam); 2) degradation of sufficient suitable habitat (gravel and woody debris poor); 3) altered hydrology from historic land management practices that has increased the magnitude and frequency of high flow events; and 4) unfavorable natural conditions in the Hood River Subbasin (glacial silt events, such as Ladd Creek / West Fork Hood River glacial outburst flood in the early 1970s, and winter flood events that wash out egg deposition or destroy newly emerged fry), which is the primary recognized cause for the demise of the population (CTWSR and ODFW 2000).

The current hatchery population of Hood River spring Chinook was introduced as part of the HRPP using Chinook from the Deschutes River. Deschutes River spring Chinook smolt releases began in 1993, while releases from Carson hatchery broodstock were made from 1986 to 1990. Table 1 presents the number of spring Chinook smolts released by the HRPP since 1993. Since 1996, the trend for returning hatchery spring Chinook has increased (see Table 1), while the population size of naturally-spawning spring Chinook remains low. However, since 2002, the trend in natural spring Chinook escapement has been on the rise, and the unofficial escapement objective of 128 adults has been exceeded in 3 out of the last 5 years (Chris Brun, CTWSR, pers. comm.). The increase appears to coincide with natural production in the Middle Fork resulting from hatchery production releases. Prior to releasing hatchery smolts in the Middle Fork, ODFW never collected spring Chinook smolts in the system. If the Middle Fork falls eliminates most of the natural production in the system, then subbasin returns of naturally produced fish may decline beginning in 2009 (estimated declines of 5-20%; Olsen, ODFW, pers comm.).

Table 1: Total Number of Chinook Smolts Released by the HRPP and Total Number of Adults (including Mini-Jacks and Jacks) Returning to Powerdale Dam

		Adult Returns								
					Hatchery [a]					
	Smolts	Wild [a b]			Carson			Deschutes		
Year	Released	M	J	A	M	J	A	M	J	A
1992		0	0	35	0	3	414			
1993	75,205	1	0	42	0	15	446	4	0	0
1994	0	0	1	33	0	0	261	0	5	0
1995	170,004	0	0	20	0	0	36	4	0	27
1996	123,230	1	1	96				0	15	2
1997	100,719	13	1	72				11	1	280
1998	123,760	5	1	80				14	2	15
1999	121,348	1	3	21				182	5	88
2000	136,926	3	0	66				918	128	20
2001	126,363	1	3	42				32	496	560
2002	128,006	0	2	71				11	24	1029
2003	113,036	2	11	100				14	15	333
2004	142,014	7	13	131				168	182	152
2005	112,844	0	7	110				71	76	587
2006	87,746	1	4	297				184	36	923
2007[1]	127,829			143						304

[1] 2007 numbers are draft and may change slightly as scales are read as per E. Olsen.
[a] M = mini-jack salmon, J = jack salmon, A = adult salmon
[b] The natural run was developed from Deschutes and Carson stock hatchery production releases

Spring Chinook Life History

No quantitative and very little qualitative life history information exists on the extinct native spring Chinook in the Hood River Subbasin. Spring Chinook probably returned to the basin during April and May, primarily as 4-year-old fish, and spawned from late August through late September (O'Toole and ODFW 1991a; O'Toole and ODFW 1991b).

Adult Migration

Natural and hatchery spring Chinook salmon begin entering the Powerdale Dam trap in late April and early May (Olsen 2007). The median date of migration for jack and adult salmon (i.e., excluding mini-jack salmon) occurs between the first two weeks of June and the last two weeks of August for the natural run, and between the last two weeks of May and the last two weeks of June for the subbasin hatchery run. Both natural and hatchery components of the jack and adult run are completed by late September to early October (Olsen 2004).

Spring Chinook in the Deschutes River generally enter the ocean in the spring at age-1+ and return at age-3 through age-5 (Underwood et al. 2003). The majority of Hood River spawners appear to be age-4 or age-5 fish (Olsen 2007; Underwood et al. 2003). Escapements to the Powerdale Dam trap ranged from 20 to 301 natural (1992-2006 run years), 36 to 461 Carson stock hatchery (1992-1995 run years), 5 to 1,056 Deschutes stock hatchery (1994-2006 run years), and 0 to 31 stray hatchery jack and adult spring Chinook salmon (Olsen 2007). Mini-jack escapements to the Powerdale Dam trap ranged from 0 to 13 natural (1992-2006 run years) and 0 to 918 Deschutes stock hatchery spring Chinook salmon (1993-2006 run years) (Olsen 2007).

Spawning

Spring Chinook spawn and rear throughout the mainstem West Fork and part way up Elk, McGee and Jones creeks, and the lower mile of Lake Branch. According to spawning surveys conducted annually since 1996 by the CTWSR (McCanna and Wyatt 2006), peak spawning occurs, on average, approximately mid-September. The vast majority of spawning occurs throughout the West Fork and Lake Branch Creek, which is about 3 RM upstream of the proposed Moving Falls facility. Although not surveyed for spawning activity, radio telemetry studies indicate that few, if any, fish spawn in the mainstem (Lambert et al. 1996). However, many fish that pass Powerdale are unaccounted for and may therefore be spawning in unsurveyed reaches (R. French, ODFW, pers. comm., 11/21/07). Spawning also occurs in the Middle Fork in Rogers Creek adjacent to the Parkdale Fish Facility and redds are occasionally observed in the East and Middle Fork tributaries (C. Brun, CTWSR, pers. comm., 11/21/07). Juvenile outmigrants have been captured in the Middle Fork screw trap, indicating that spawning occurs in the tributary. No wild spring Chinook smolts were captured in the fork prior to hatchery supplementation. Anecdotal reports of redds in clear water tributaries to the East Fork and small numbers of juveniles counted at the East Fork screw trap and during ditch salvage efforts indicate that some spring Chinook spawn in the East Fork drainage (C. Brun, CTWSR, pers. comm., 11/21/07).

Egg Incubation and Fry Emergence

According to Piper et al. (1982), spring Chinook eggs may experience mortality in temperatures below 5°C (41°F) and above 15°C (59°F) (Piper et al. 1982). Spring Chinook eggs in the Hood River Basin are generally not subjected to temperatures beyond these tolerance limits. Egg-to-smolt survival may be affected, however, by the later emergence in the Hood River (see discussion below). High flow events, occurring as early as November and December and peaking in February (Figure 3) due to rain-on-snow events may have detrimental effects on eggs in the gravel. These peak flows may scour pre-emergent fish out of the gravel, thus reducing survival. If emergence occurs at the beginning of February, as was suggested for the Warm Springs River (Deschutes River Basin), fry may experience greater survival.

Although emergence timing was not studied in the Hood River, thermograph data and spawn timing predicts that spring Chinook fry emerge beginning in mid-March (Underwood et al.

2003). Piper et al. (1982) determined that Chinook eggs require about 450 daily temperature units (DTUs) to achieve eyed stage, 750 DTUs to hatch, and 1,600 DTUs to emerge. Fry were detected in both the mainstem and West Fork migrant traps from late March through mid-June. This observation may be an artifact of sampling period as screw traps are not operated earlier than March due to logistical issues. In contrast, fry emergence from natural spawning in the Warm Springs River was slightly earlier, beginning in February. The difference in emergence times between the Hood River and Warm Springs River appeared to be driven by water temperature. The Warm Springs River was slightly cooler in the summer, resulting in peak spawning two weeks earlier than in the Hood River. Furthermore, the Warm Springs River was slightly warmer during the winter months after hatching. Theoretically, the Warm Spring population could have emerged an entire month before the Hood River population.

Juvenile Rearing

Juvenile Chinook rear primarily in both the mainstem Hood River and in the West Fork, and to a lesser extent in the Middle Fork of the Hood River. In 1994, the estimate of fall migrants at the West Fork trap was 3,385 pre-smolts/smolts and at the mainstem traps was 20,227 pre-smolts/smolts. Mean length at the traps supports the hypothesis that the greater percentage of subbasin rearing occurs in the mainstem Hood River. Mean fork length of fall migrant spring Chinook at the mainstem trap can be as much as 16 mm greater than the West Fork migrants and 20 mm greater than the Middle Fork migrants. Given the large sample sizes at each trap, the difference would suggest that a considerable portion of the population must be rearing in the mainstem Hood River where growth is presumably greater than in the forks (Olsen, ODFW, pers comm.).

Temperatures in the West Fork's primary spring Chinook spawning reaches remain above 9°C (48°F) from June to late September, allowing about 3 months for optimal growth. Tributaries to the West Fork had less optimal growing opportunity at 1.5-2 months of temperatures of 9°C (48°F) or greater. The presence of deep pools in the West Fork likely contributes to increased juvenile rearing densities of spring Chinook (Underwood et al. 2003). Tributaries with a high gradient are not likely used for rearing (Figure 5).

The presence of excessive fine sediments can be detrimental to rearing juveniles and result in reduced densities (Bjornn et al. 1977, Thompson and Lee 2000, Cramer 2001). As stated in Underwood et al. (2003), Cramer (2001) determined through literature reviews that fines exceeding 15% of the substrate in riffles had a negative effect on the potential rearing capacity of a given reach. Because the West Fork is the least glacially-influenced, the amount of fine sediment observed within this system was consistently less than 15% in the substrate. However, the amount of fine sediment in the East Fork (nearly 40%) and Middle Fork (25%) is much higher due to glacial flour (Underwood et al. 2003). The high presence of fines in much of the Hood River due to glacial melting likely limits the Chinook salmon production potential of the basin.

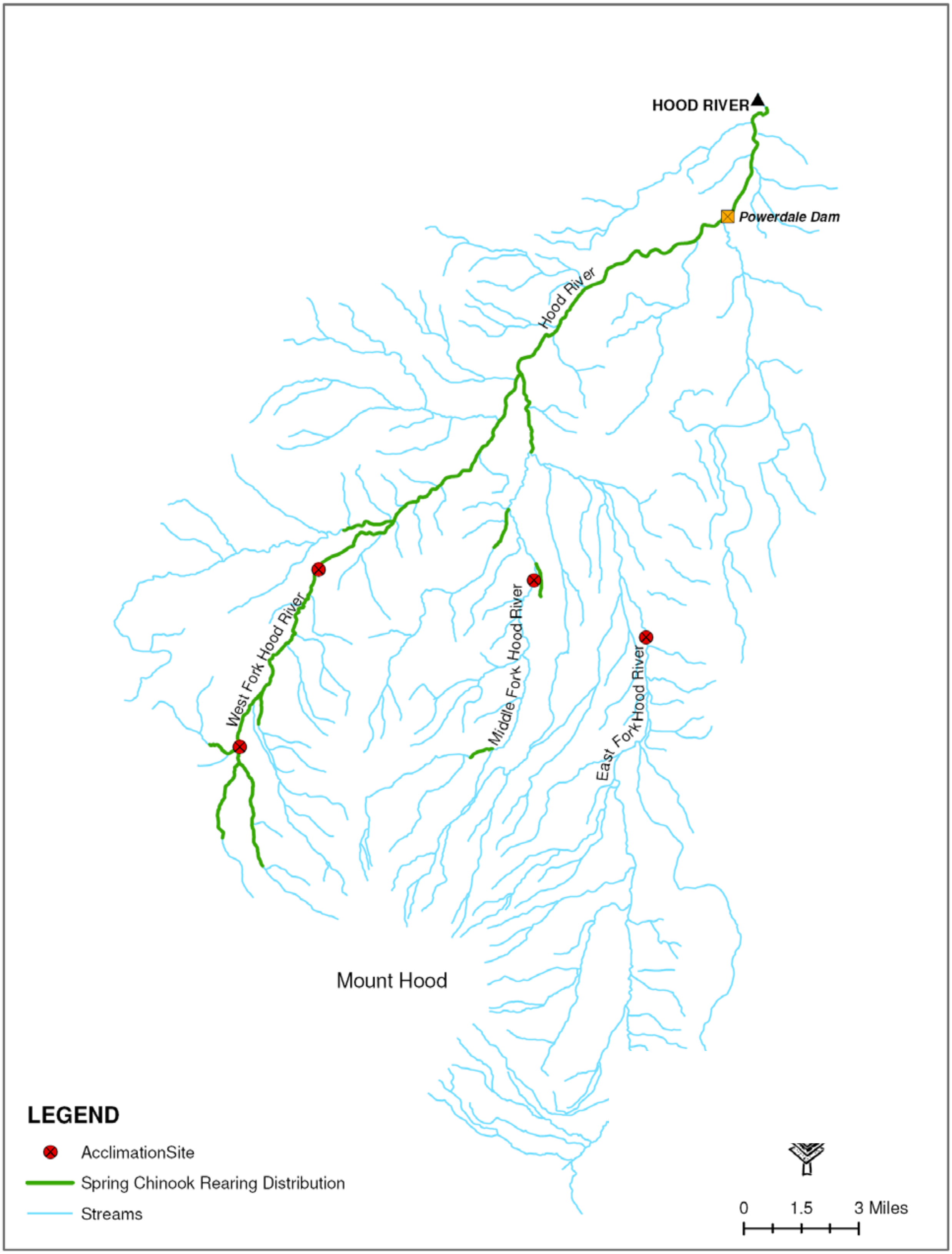


Figure 5: Generally Accepted Distribution of Spring Chinook Rearing in the Hood River Basin (From Underwood et al. 2003)

Smolt Migration

Screw trap data from the West Fork indicates some juveniles emigrate as fry in the spring (early March to mid-June) or in the fall (Underwood et al. 2003). Recent observations indicate that a substantial number of 0+ fish overwinter in the upper West Fork (C. Brun, CTWSR, pers. comm., 11/1/07). Olsen (2004) determined that naturally-produced spring Chinook salmon migrate as both sub-yearling and yearling smolts. Catches of age 1+ smolts in the spring at the mainstem trap indicated that many fish emigrated as smolts in the spring. However, the most significant trap catch, by far, occurs in the fall (i.e., age 0+ migrants) (Olsen, ODFW, pers comm.).

Olsen et al. (1994) identified an unusual growth pattern in spring Chinook scales showing accelerated growth for a short period before entering salt water. This was odd because accelerated growth implied the fish migrated into the mainstem Hood or Columbia rivers during the fall, a life history pattern not believed to be expressed in the lower Columbia River spring Chinook. This unique life history pattern could be the result of misidentified fall Chinook and strays, or due to unusual behavior of the Carson stock. Olsen et al. (1995) suggested that the Carson stock could be maladapted for the Hood River causing them to outmigrate in the fall. However, genetic studies on wild Hood River Chinook have not been conducted to date so the origin of these fish is unknown, but the stock may have a fall migration component.

Ocean Rearing and Survival

The ocean distribution of Deschutes-origin spring Chinook released from the Hood River Basin is not well understood. Some Hood River hatchery Chinook have been sampled in the high seas at 48 N 124 W off the northern Washington coast. Hood River spring Chinook generally enter the ocean in the spring at age 1+ and return at age 3 through age 5, indicating a 2 to 4 year period spent in the ocean. Scale analysis from the Hood River indicates a similar age distribution (R. French, ODFW, pers. comm., 11/21/07).

Survival from smolt to returning jack and adult salmon back to the Powerdale Dam trap appears to vary widely among age categories for hatchery production releases of both the Carson and Deschutes stocks of spring Chinook salmon (Olsen 2007). Post-release survival from smolt to jack and adult return back to the Powerdale Dam trap ranged from 0.180% to 0.187%, and averaged 0.183%, for the Carson stock (1989-1990 broods) and ranged from 0.011% to 1.87%, and averaged 0.405%, for the Deschutes stock (1991 and 1993-2001 broods) (Olsen 2007).

C.2.2 Steelhead

Status of Steelhead in the Hood River Basin

Both summer and winter run steelhead populations exist in the subbasin. Harvest records indicate that thousands of steelhead (both hatchery and wild) returned to Hood River each year during the 1960s. According to ODFW (2007) the winter steelhead population is at moderate risk of extinction, while the summer steelhead population is more fragile, and is at very high risk of extinction.

The indigenous summer steelhead hatchery program began releasing smolts in 1999. Table 2 shows the total release of summer steelhead smolts by the HRPP as well as the total adult returns of both wild and hatchery steelhead in the Hood River.

The BPA-funded indigenous winter steelhead hatchery program began releasing fish (Table 2) into the East Fork in 1993 and into the Middle Fork in 1999. Hatchery-produced adults began returning a year after release. From 1996 through 1998, greater numbers of hatchery adults returned to the Powerdale Fish Trap than wild adults, but from 1999 to 2002 wild fish dominated adult returns. Total adult returns for hatchery and wild summer and winter steelhead, and hatchery smolt releases are shown in Table 2.

Table 2: Total Number of Steelhead Smolts Released by the HRPP and Skamania Program and Total Number of Adult Returns to Powerdale Dam for Both Hatchery and Wild Summer and Winter Steelhead

	Summer Steelhead					Winter Steelhead		
	Smolts Released		Adult Returns			Smolts Released	Adult Returns	
Year	HRPP Stock	Skamania Stock	Wild	HRPP Stock	Skamania Stock	HRPP Stock	Wild	Hatchery
1991 /original Objective	150,000	75,000	1,200	6,800	n/a	85,000	1,200	3,800
Current Objective	40,000	Program ended	600	0	0	50,000	1,100	876
1992	-	70,928	165	-	513	-	399	-
1993	-	90,042	84	-	1,335	48,985	377	1
1994	-	76,330	123	-	692	38,034	194	83
1995	-	68,378	199	-	460	42,860	269	259
1996	-	60,993	199	-	444	50,896	274	613
1997	-	64,910	613	-	1,434	59,837	208	365
1998	-	62,218	485	542	1,581	62,133	289	304
1999	19,513	49,278	272	817	1,600	46,781	904	290
2000	33,899	62,354	241	468	1,344	63,182	1,000	897
2001	37,665	58,711	149	1,262	1,862	50,879	1,032	922
2002	45,658	28,981	128	465	513	62,921	718	468
2003	47,513	18,730	33	412	347	51,433	577	924
2004	40,429	31,269	-	88	-	59,407	333	451
2005	49,956	32,148	-	-	-	79,486	439	817
2006	34,049	-	-	-	-	36,795	-	-

Sources: Underwood et al. 2003, Olsen 2007; [1] Coccoli 2004

Summer Steelhead Life History

Adult Migration

Wild and hatchery (i.e., both Foster/Skamania [Foster] and Hood River stocks) summer steelhead begin entering the Powerdale Dam trap during late February to early March, and a given run year encompasses two calendar years for both stocks of the run. The median migration date past Powerdale Dam typically occurs from early July to late September for the wild run, from early June to late July for the Foster stock component of the hatchery run, and from early September to mid- October for the Hood River component of the hatchery run (Olsen 2007). The peak migration as, observed at the Powerdale Fish Trap, occurs during June and July (Olsen 2007). Migration to the Powerdale Dam trap was completed by late April to late May of the second calendar year for both the wild and subbasin hatchery components of the run. Pre-spawning adults remained in the river from the time of their arrival (March-November) until spawning the following spring (May-June).

Spawning

Summer steelhead likely spawn from March through June of the year following their return to freshwater (Underwood et al. 2003). Summer steelhead spawn in the West Fork Hood River (CTWSR and ODFW 2000) and associated tributaries including McGee and Elk creeks, and several tributaries below including Lake Branch (Underwood et al. 2003). Repeat spawners at the Powerdale Dam trap comprised 1.7% to 9.2% of the wild summer steelhead run, 0.6% to 3.2% of the Foster stock hatchery summer steelhead run, and 0% to 2.3% of the Hood River stock hatchery summer steelhead run (Olsen 2004).

Egg Incubation and Fry Emergence

Egg incubation studies have not been conducted in the Hood River, thus, stock-specific egg incubation timing data are not available. However, based on Hood River water temperatures, fry should emerge from June through August (Underwood et al. 2003). Screw trap data collected at RM 4.5 of the West Fork indicated small numbers of fry present from June through August.

Juvenile Rearing

It is believed that summer steelhead are generally distributed throughout the entire West Fork drainage, and recent evidence suggests that they are distributed in other forks (R. French, ODFW, pers. comm., 11/21/07). Trapping results suggests that juveniles may migrate from the West Fork to rear in the mainstem (R. French, ODFW, pers. comm., 11/21/07) . The West Fork has an extensive amount of deep pools, which may contribute to increased juvenile densities in the tributary (Figure 6).

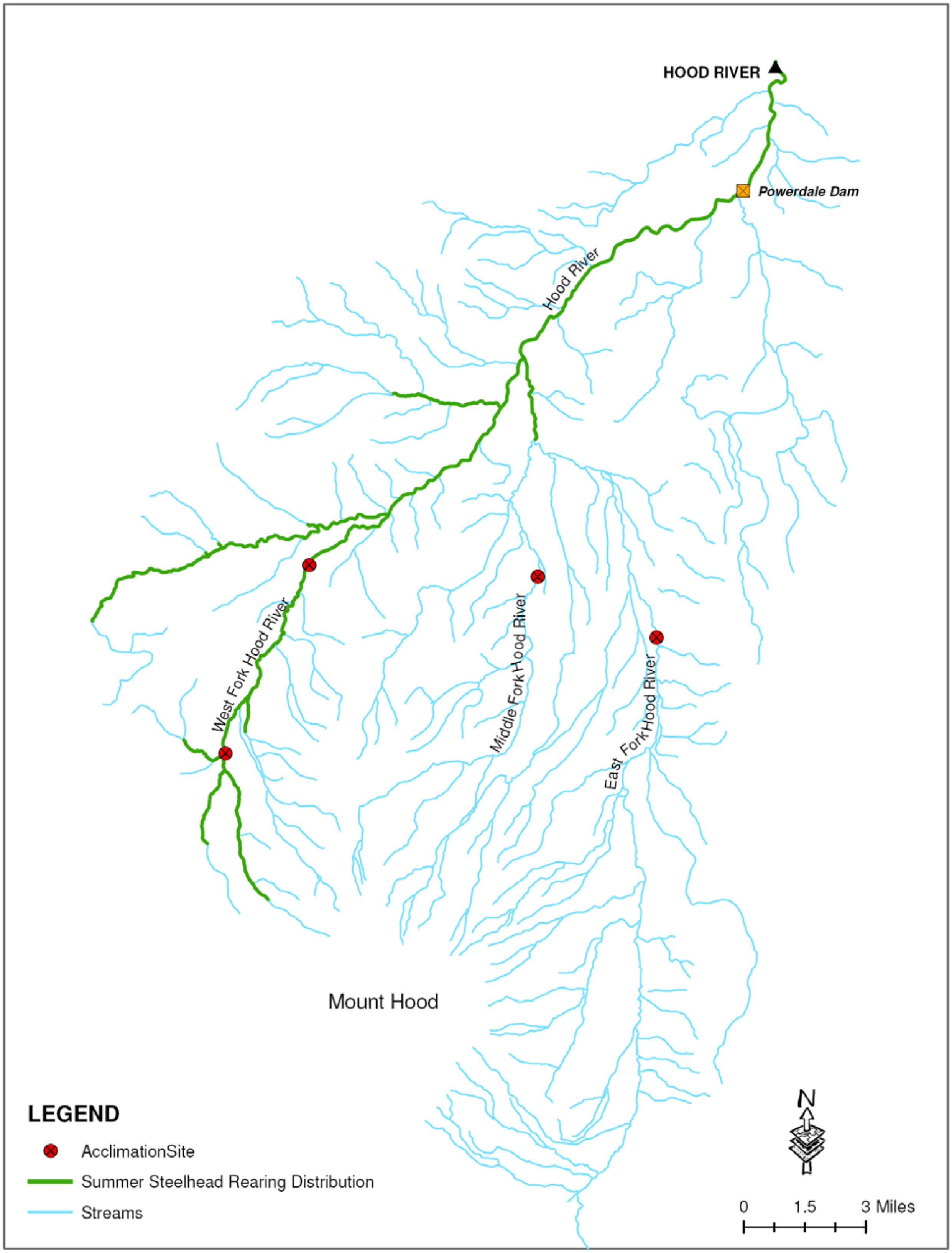


Figure 6: Generally Accepted Distribution of Summer Steelhead Rearing in the Hood River Basin (From Underwood et al. 2003)

Smolt Migration

Summer steelhead smolts typically migrate past the West Fork and mainstem screw traps from mid-April to mid-June. Scale analysis of wild summer steelhead outmigrants suggested that smolts ranged in age from 1-3 years old with the majority of summer steelhead spending 2 years in freshwater (Olsen 2000 and 2003). Smolts (fork length greater than 150 mm) begin migrating from the basin from late March through July, with peak migration occurring during early May. Fish less than 150 mm are believed to be presmolts (ages 1-2) that rear downstream until becoming smolts the following spring (Olsen 2002; 2003; 2007). According to combined data at the West Fork and mainstem, it appears that age 0 and age 1 fish moved out of the West Fork and reared in the mainstem above Powerdale. This suggests that the upper mainstem Hood River may provide important rearing habitat for the wild summer steelhead population (Underwood et al. 2003).

Ocean Rearing and Survival

Summer steelhead return to the Hood River at 2 to 6 years of age with most at age 4. Returning adults likely spend from 1 –3 years in the ocean, with the average length of time spent in the ocean being 2 years (Olsen 2004).

Smolt-to-adult survival back to the mouth of the Hood River Subbasin, by year of migration, ranged from 0.98% to 4.52% for Foster stock releases (1994-2002) and ranged from 1.49% to 3.72% for Hood River stock releases (1999-2002) (Olsen 2007). The post-release smolt-to-adult survival rate of Foster stock releases ranged from 57% to 86% lower than the smolt-to-adult survival rate for wild steelhead migrating as smolts in the same years (1994-2002), while the post-release smolt-to-adult survival rate of Hood River stock releases ranged from 70% to 92% lower than the smolt-to-adult survival rate for wild steelhead migrating as smolts in the same year (1999-2002) (Olsen 2007).

Winter Steelhead Life History

Adult Migration

Wild winter steelhead are believed to begin entering the Hood River Subbasin around the last two weeks of December and the first two weeks of January (Olsen 2004). The run rapidly increases throughout March, peaks in late April, and then rapidly declines in May. Hood River stock hatchery winter steelhead do not escape to the Powerdale Dam trap in any significant numbers until late January and early February, with peak migration from late February to late April. Migration to the Powerdale Dam trap is completed for both wild and Hood River hatchery components of the run by late June (Olsen 2004).

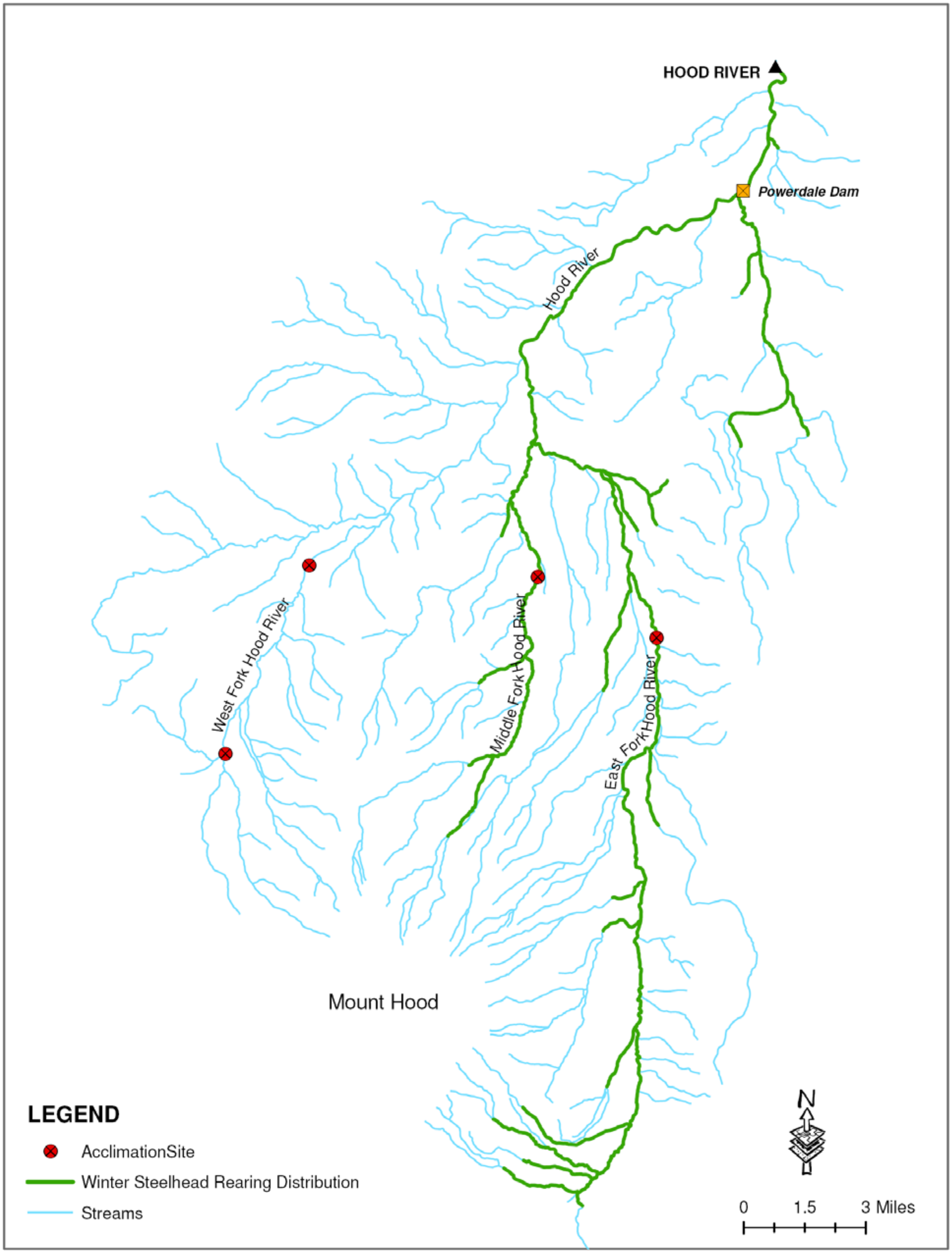


Figure 7: Generally Accepted Distribution of Winter Steelhead Rearing in the Hood River Basin (From Underwood et al. 2003)

Winter steelhead spawn primarily in the mainstem Hood River and in both the Middle and East fork drainages of the Hood River (Coccoli 2002) (Figure 7). Distribution in the East Fork extends to Sahalie Falls and includes tributaries below the falls. Neal Creek is another important spawning tributary and, Green Point Creek appears to be a winter steelhead production area (Olsen, ODFW, pers comm.). In the Middle Fork, distribution extends to Clear Branch Dam, part way up Coe Branch and in several tributaries below (ODFW 2007). Radio telemetry studies of adult steelhead conducted by ODFW indicated that roughly 95% of the fish assigned to the summer run at the Powerdale Adult Trap spawned in the West Fork, while a similar percentage assigned to the winter run spawned in either the East or Middle forks (Underwood 2001).

Spawning

Winter steelhead spawn from March through May (CTWSR and ODFW 2000). Repeat spawners at the Powerdale Dam trap comprised 2.5% to 13.2% of the wild winter steelhead run and 0% to 5.2% of the Hood River stock hatchery winter steelhead run (Olsen 2004). Winter steelhead spawn primarily in the mainstem, Middle Fork, and East Fork of the Hood River (Coccoli 2000).

Egg Incubation and Fry Emergence

Egg incubation studies specific to Hood River steelhead have not been conducted. However, based on water temperatures, emergence should occur from June through August (Underwood et al. 2003). Screw trap data verify this emergence timing as fry are collected at the mouth of the East and Middle forks from June through August.

Juvenile Rearing

It is believed that winter steelhead generally spawn and rear throughout the entire mainstem and its tributaries; excluding the West Fork drainage with the exception of Green Point Creek. The East and Middle Fork do not contain as many deep pools as the West Fork; however, the abundant high gradient habitat in these reaches is well suited for steelhead rearing, because they have high boulder composition which creates forage opportunities for juvenile steelhead (Don Chapman Consultants 1989, Fausch 1993, Johnson 1985).

Smolt Migration

Hood River steelhead smolts exhibit three freshwater life history patterns. They typically emigrate as two year olds; however, some emigrate at one year and some at three years (Olsen 2007). Hatchery steelhead are released from early April to mid-May, following one to two weeks of acclimation, to coincide with the natural smolt migration timing.

In the East and Middle forks, steelhead/rainbow trout with a fork length (FL) greater than 150 mm (roughly equating to age 2-3 migrants) and less than 150 mm (roughly age 1) outmigrate in the spring (mid-April through mid-June). In the Middle Fork, outmigration for juveniles under 150 mm in FL peaked in July, much later than in the East Fork, which exhibited a weaker peak in April, but continued through July. Beginning in August, the measured size classes are adjusted to greater than or less than 100 mm to distinguish between young-of-year and age-1 or greater migrants. East Fork fish exhibited a strong outmigration during fall of both size classes. The Middle Fork fall migration was not as pronounced as the East Fork. The Middle

Fork outmigration pattern appeared very similar to that in the West Fork (CTWSR and ODFW 2000).

Data collected from the mainstem screw trap indicated the greatest percent of emigration occurred in the spring with fewer fish emigrating in the fall. A majority of the wild juveniles appeared to leave the East Fork in the fall and reside in the upper mainstem until the following spring. Fall emigrants may represent fish moving out of the East Fork due to an unknown habitat deficiency forcing the fish to move into the upper mainstem to overwinter. The primary habitat deficiency is probably associated with a significant drop in streamflows. Summer flows below the EFID diversion have dropped as low as 15 cfs (recorded in 1992; Olsen 2007) and in some years (prior to the M&E project) the reach between EFID and our staff gage has exhibited intermittent flows.

Ocean Rearing and Survival

Wild winter steelhead migrate mainly as freshwater age-2 and age-3 smolts and return mainly as 2-salt adults. Subbasin hatchery winter steelhead migrate as freshwater age-1 and age-2 smolts and return mostly as 2- and 3-salt adults (Olsen 2004).

Survival from smolt-to-adult return back to the mouth of the Hood River Subbasin, by year of migration, ranged from 0.65% to 2.92% for Hood River stock hatchery winter steelhead released as smolts from 1994-2002. The post-release smolt-to-adult survival rate of Hood River stock hatchery winter steelhead smolts released from 1994-2002 ranged from 64% to 92% lower than the smolt-to-adult survival rate for wild steelhead migrating as smolts in the same years (Olsen 2007).

C.2.2 Bull Trout

Bull trout (*Salvelinus confluentus)* in the Hood River Subbasin (Coccoli 2004) are part of the Columbia River Distinct Population Segment (DPS), which was listed as federally threatened in 1998 by the U.S. Fish and Wildlife Service (USFWS; 63 FR 31647). Within the Columbia River DPS, USFWS identified 22 recovery units, one of which was the Mt. Hood Recovery Unit (RU). As identified in the USFWS Bull Trout Recovery Plan (2003), two local populations exist within the RU, one in Clear Branch and one in the Hood River. The Mt. Hood RU encompasses the Hood River drainage in its entirety, and drainages eastward up to and including Fifteen Mile Creek, westward up to and including the Sandy River, and the adjacent mainstem Columbia River. The northwestern limit of the Mt. Hood RU extends to Bonneville Dam. The Hood River drainage is identified as the core habitat area within the Mt. Hood RU because it currently supports the only known spawning population of bull trout in the unit. Bull trout migrate seasonally from the Hood River to the mainstem Columbia River using the Columbia during part of their life history.

Status of Bull Trout in the Hood River Basin

A comprehensive population assessment for bull trout is currently being conducted. Coccoli et al. (2004) report that the total number of adult bull trout in the recovery unit is believed to be less than 300. A population size of at least 500 adults is recommended in order for the population to be considered recovered (USFWS 2003). The USFWS identified the bull trout population in the Hood River as a unique population unit. Hood River bull trout are thought to exist as two independent reproductive units (USFWS 2004), known as local populations (Rieman and McIntyre 1995). These are the Clear Branch and the Hood River local populations, and the status of each population is currently considered "extremely precarious" (Starcevich and Jacobs 2007).

The Clear Branch Dam, constructed in 1969, separates the Hood River population from that of the Clear Branch. The Clear Branch local population occurs in Laurance Lake Reservoir and in Clear Branch and Pinnacle Creek above the Dam. This population is considered the stronghold for the recovery unit where bull trout numbers are highest and where high-quality habitat is most available. The Clear Branch population is at risk of a random extinction event due to low numbers, negative interactions with non-native smallmouth bass, isolation and limited spawning habitat (USFWS 1998). The Hood River local population has fewer bull trout and occurs in Clear Branch below the dam, the Middle Fork Hood River and several tributaries, the Hood River mainstem, and the Columbia River. Spawning has been confirmed in Compass and Bear creeks (Coccoli 2004). However, between 1999 and 2003, lower Compass Creek was overtaken by Coe Branch, a glacial stream. It is not known whether Compass Creek still provides suitable spawning habitat, and it is possible that an entire generation of bull trout in Compass Creek was lost during this event (D. Morgan, pers. comm., 2003 in Coccoli 2004). The Hood River population appears to be small and is threatened by passage barriers, unscreened irrigation systems, impaired water quality and periodic siltation of spawning substrate by glacial outbursts.

Snorkel surveys conducted in Clear Branch above Clear Branch Dam found annual high counts of 51 to 200 adult and juvenile bull trout between 1996 and 2003 (Coccoli 2004), though recent studies indicate there is not significant resident population in Clear Branch (Starcevich and Jacobs 2007). August 2007 snorkel surveys of the Clear Branch reaches resulted in abundance estimates ranging from 90 to 95 adult bull trout, and a 2006 electrofishing mark-recapture population estimate resulted in a Lincoln-Petersen population estimate of 513 bull trout (±61%) (Starcevich and Jacobs 2007). Juvenile trapping conducted in the Clear Branch downstream-migrant trap, located about 400 m upstream of Lake Laurance Reservoir, collected 136 juveniles from May through October 2006, while 42 juveniles were captured in 2007 (Starcevich and Jacobs 2007).

Distribution and Life History of Hood River Bull Trout

The current bull trout distribution occurs in 4 major subbasin areas: the Hood River, the West Fork Hood River, the Middle Fork Hood River, and the Clear Branch of Hood River (USFWS 2003). The Middle Fork and mainstem Hood River provide foraging, migration and overwintering habitat. Spawning activity of the Hood River local population has been observed in a few locations within the Middle Fork of Hood River (Starcevich and Jacobs 2007). Juvenile rearing and potential redds have been observed in the Middle Fork mainstem and its tributaries including Bear Creek, Compass Creek and Coe Branch (USFWS 2003; Starcevich, S. and S. E. Jacobs 2007). However, Coe Branch, Compass Creek, and the Middle Fork are glacial streams with a high volume of sand and silt which may compromise spawning success.

No bull trout spawning or rearing has been observed on the East and West Forks of Hood River. Bull trout distribution in the West Fork is based on isolated, infrequent sightings Past sightings in the East Fork Hood River are considered incidental and bull trout use of the East Fork is thought to be unlikely due to unsuitable habitat conditions and absence of bull trout during surveys (USFWS 2003).

Hood River bull trout are also known to migrate into the Columbia River. Two bull trout tagged at Powerdale Dam (RK 7.2 of mainstem Hood River) were recovered near Drano Lake in Washington State; and one was captured 11 kilometers downstream of the confluence of the Hood and Columbia Rivers (USFWS 2004). Every year (usually between May and July), adult bull trout, presumably migrating upstream from the Columbia River, are captured and anchortagged at Powerdale Dam. Although some of these tagged fish have been observed upstream (one in Coe Branch and three below Clear Branch Dam), the spawning destination of fluvial adults within the Hood River Basin is largely unknown (Starcevich and Jacobs 2007).

Bull trout adult migrants are typically observed migrating upstream at Powerdale Dam from May through July, although there have been observations from August to October (CTWSR and ODFW 2000). Bull trout spawn from August through October exclusively in the tributaries of the Middle Fork, including the Coe and Clear branches. Hatchery spring Chinook salmon and steelhead smolts are released into the Middle Fork downstream from primary bull trout rearing habitat (CTWSR and ODFW 2000).

The debris flow in the Middle Fork in November, 2006, resulted in what appears to be a new passage barrier and has isolated bull trout below Clear Branch Dam from their spawning grounds. High flows during future winters could potentially alter the structure of the falls, but for now it appears to be a barrier to adult and juvenile bull trout.

Threats to Hood River Bull Trout

Hood River bull trout are threatened by periodic natural disturbance events, such as glacial outbursts, that are relatively frequent within the spawning areas. Well-distributed and more numerous local populations are essential to spread the risk of these disturbance events. Bull trout in the subbasin are also threatened by isolation and habitat fragmentation from passage barriers including dams, impaired water quality, and habitat impacts from past and ongoing forest management and water diversion for irrigation (USFWS 1998).

C.2.4 Coho Salmon

Little data is available regarding the status of endemic coho salmon populations in the Hood River. However, the Oregon Lower Columbia Recovery Plan states that this population is at a very high risk of extinction (ODFW 2007). Adult returns to Powerdale Dam prior to 2003 were consistent with returns in the early 1990’s, indicating that no significant decline in the population above Powerdale Dam has occurred (Underwood et al. 2003). The native coho salmon population in the Middle Fork Hood River was eliminated in 1969, when about a quarter of a mile of spawning habitat was inundated by the construction of Clear Branch Dam (Coccoli 2004). The USFS (1996) observed coho smolts in the East Fork Irrigation Ditch.

According to Underwood et al. (2003), most adult coho passing Powerdale Dam are out of basin strays. Returns increased somewhat dramatically in 2001, when 996 hatchery strays returned to the basin, compared to a range of returns from 6-80 hatchery strays from 1992 to 2000. The cause of this sudden increase may have been due to strays from new hatchery programs in the mid Columbia and Snake River basins. If these fish successfully reproduce in the Hood Basin, they may constitute an opportunity for reestablishment of naturally producing coho, and interactions with HRPP fish should be monitored. Beginning in 2001, hatchery coho were recycled and wild fish/unmarked hatchery fish were passed above Powerdale Dam.

Hatchery releases of adult and juvenile hatchery coho salmon have historically occurred in the Hood River using both nonindigenous and Hood River stocks; however, no releases of coho salmon have occurred since 1977 (Coccoli 2004).

APPENDIX D: LIMITING FACTORS

This section summarizes the limiting factors and threats that are specific to Hood River salmon and steelhead and draws heavily on the analyses presented in the Subbasin Plan (Coccoli 2004) and the Draft Oregon Lower Columbia Recovery Plan (ODFW 2007). Table 1 identifies the key and secondary threats and limiting factors to recovery of the Hood River populations, which are described in more detail following the table.

Table 1. Key and Secondary Limiting Factors and Threats to Recovery of Hood River Summer and Winter Steelhead and Spring Chinook (from ODFW 2007).

Threats	Population	Tributaries								Mainstem Columbia (above Bonneville)				Estuary (below Bonneville and Willamette Falls)				Ocean
		Eggs	Alevins	Fry	Summer Parr	Winter Parr	Smolts	Returning Adults	Spawners	Fry	Fingerling/ Sub-yearling	Yearling	Returning Adults	Fry	Fingerling/ Sub-yearling	Yearling	Returning Adults	Adults
Harvest	SC																●	●
	WS												○				○	
	SS												○					
Hatcheries	SC								●		○	○			○	○		
	WS								○		○	○			○	○		
	SS								○		○	○			○	○		
Hydro	SC			○	○			○			○	○	○		⊙	⊙	○	
	WS			○	○	○		○			○	○	○		⊙	⊙	○	
	SS			○	○	○		○			○	○	○		⊙	⊙	○	
Landuse	SC	○	○	○	○										⊙	⊙		
	WS	○	○	⊙	⊙	⊙		○							⊙	⊙		
	SS	○	○	⊙	⊙	⊙									⊙	⊙		
Introduced Species	SC										○	○						
	WS										○	○						
	SS										○	○						

* Black circles indicated key concerns; hollow circles cells indicated secondary concerns; half filled circles indicate key and secondary concerns.
* SC = Spring Chinook; WS = Winter Steelhead; SS = Summer Steelhead

D.1 Harvest

One of the goals of the HRPP is to contribute to tribal and non-tribal fisheries in the Hood River Subbasin. Harvest does not appear to be a significant factor in limiting the success of the HRPP and incidental take has not been identified as a limiting factor. Conservation measures implemented in 1992 to protect wild steelhead resulted in regulations banning the harvest of endemic steelhead. The Hood River has been closed to all sport salmon and steelhead fishing above Powerdale Dam since 1998. The West Fork is closed year round to all angling in order to protect juvenile steelhead.

D.2 Hatcheries

Fisheries co-managers face several challenges building and maintaining robust spring Chinook, summer steelhead and winter steelhead fisheries. One challenge is producing a hatchery fish with fitness similar to wild fish that will provide sufficient numbers of returning adults to meet the subbasins numerical harvest objectives. The current practice of rearing hatchery spring Chinook outside of the Hood River subbasin appears to contribute to straying, thereby reducing returns to the Hood River (Underwood et al. 2003). Current rearing practices produce spring Chinook juveniles that mature rapidly, resulting in jacking and smoltification prior to release into the Hood River and its tributaries . An additional challenge is managing hatchery fish effects on wild fish. Powerdale Dam and fish trap is in the lower mainstem and is the location where fish are either passed upstream or blocked. Since 1996, the spring Chinook management strategy is to allow all wild and hatchery fish pass upstream (other than those collected for broodstock (~150) to spawn naturally or to be captured by the tribal fishery. Underwood et al. (2003) suggested that 128 spawning spring Chinook adults would seed the available habitat. Recent management strategy has allowed as many as 693 hatchery and 298 wild fish the opportunity to spawn upstream of the dam in any one year. This practice is likely over-seeding the habitat and has the potential to select for gene complexes less fit in the natural environment by diluting successful wild genes with less fit hatchery genes. The HSRG recommend no greater than 5% of the natural spawning fish be comprised of hatchery fish to limit potential introgression of misfit genes.

The winter and summer steelhead programs minimize over-seeding by maintaining smaller programs consistent with estimated carrying capacity, and, as previously discussed, the summer steelhead program is proposed for discontinuation. Elimination of the summer steelhead program is based on recent findings by Araki et al. (2007) that suggest sharp declines in reproductive success follow a very short period of captivity when second-generation hatchery-reared fish are used for broodstock. Because the wild summer steelhead population is critically low, cessation of the hatchery program, along with the recent discontinuation of the Skamania program, is intended to decrease the risk of reduced fitness to wild fish (through intermixing of second-generation hatchery stock and wild stock). Similarly, modifications to the winter steelhead broodstock collection protocols (described in detail in Chapter 5) will consider the results of Araki et al. (2007).

D.3 Habitat

D.3.1 Ocean/Estuary

Events that take place within the Pacific Ocean and Columbia River estuary, both natural and anthropogenic, may have a direct effect on the survival of salmon. For example, dredging of the Columbia River and filling of estuarine wetlands over the past century have implied effects. Dredging activities and the resulting deposition into wetlands not only have an effect on water quality, but may have affected the ability of the estuary to support salmon smolts as they make the transition to salt water.

In addition to habitat loss and degradation in the Columbia River estuary, the presence of predators, including seals and sea lions, affect salmonid populations. Marine mammals (sea lions) prey on migrating adult salmon and steelhead, primarily spring Chinook and winter steelhead, in the lower Columbia River and as they prepare to pass over Bonneville Dam. Fall Chinook, chum and summer steelhead are less impacted by this predation because they usually arrive later when fewer sea lion are present below the dam (ODFW 2007). Pikeminnow also prey on migrating salmonids, often congregating at dam bypass outfalls and hatchery release sites to feed on smolts. Although a pikeminnow management program exists that rewards anglers for harvesting pikeminnows over a certain size, predation by pikeminnows (and walleye) remains a limiting factor for juvenile salmonids.

Perhaps the most voracious predators on salmonid smolts are bird species including Caspian terns and cormorants. The world's largest colony of Caspian terns and the two largest colonies of double-crested cormorants on the west coast of North America are now well established in the Columbia estuary (NMFS 2000).

Potential impacts to wild juvenile salmonids may occur as a result of hatchery operations in the Columbia and Snake River basins. Naturally-produced juvenile salmonids may suffer density-dependent mortality due to large pulses of hatchery fish into an estuary with reduced and degraded habitat. Food web dynamics and juvenile productivity may be limited in the estuarine environment due to dredging, the presence of navigational structures, the construction of revetments along estuary shorelines, disposal of dredged material in formerly shallow or estuarine wetland areas, and reductions in flow and associated sand discharge due to the hydro system (ODFW 2007). Temperatures of river water entering the Columbia River estuary have been elevated by the impoundment of water above Columbia River Basin dams. Agricultural practices in the estuary and throughout basin contribute water-soluble contaminants and other potentially toxic contaminants. Urban and industrial practices create toxic chemicals that are transported to the estuary.

According to Anderson (1997), ocean climate regime shifts over the past few decades likely have contributed to the decline of Pacific Northwest salmon populations. Studies detailing the cyclic changes in ocean conditions have been emerging since the early 1900s. Recent studies indicate the warm and cool regimes appear to persist over about two decades; therefore, it is reasonable to expect that ocean conditions are and will continue to be cyclic. It is believed by many that good ocean conditions were experienced in the early 2000's and that conditions may now be declining (R. French, ODFW, pers. comm., 11/21/07).

D.3.2 Freshwater

Historic logging and clearing of streams and riparian areas in the Hood River subbasin has decreased large woody debris recruitment, and reduced pool area, pool complexity and pool frequency. Today most channels lack the complex structure needed to retain gravels for spawning and invertebrate production (Coccoli 2004).

According to the Subbasin Plan (Coccoli 2004), the EDT model determined that there are five key factors that limit anadromous salmonid production in the Hood River Subbasin: channel stability, flow, habitat diversity, sediment load, and key habitat quantity. Other factors having lesser effects included obstructions, chemicals, and food. Limiting factors and their level of effect were assessed for each of the life stages presented in Table 2, which demonstrates that a limiting factor at one life stage may have little to no effect at another life stage.

Table 2: Summary of the Primary Limiting Factors Identified by EDT for Specific Life Stages for Spring Chinook, Summer Steelhead and Winter Steelhead[1]

Life Stage	Limiting Factors					
	Key Habitat Quantity	Habitat Diversity	Channel Stability	Sediment Load	Obstructions	Flow
Spring Chinook						
Spawning	X	X				
Egg incubation	X		X	X		
Fry colonization	X	X				
0-age active rearing	X	X				
0-age migrant	X	X				
0-age inactive (winter inactivity)	X	X		X		
1-age active rearing	X	X				
1-age migrant		X			X[1]	
1-age transient rearing						
2+ - age transient rearing						
Pre-spawning migrant		X			X	
Pre-spawning holding	X	X				X

Life Stage	Limiting Factors					
	Key Habitat Quantity	Habitat Diversity	Channel Stability	Sediment Load	Obstructions	Flow
Summer and Winter Steelhead						
Spawning	X	X				
Egg incubation	X		X	X		
Fry colonization		X	X	X		X
0-age active rearing		X				X
0-age migrant		X	X	X		X
0-age inactive (winter inactivity)	X	X				
1-age active rearing	X[2]	X				X
1-age migrant		X				X
1-age transient rearing		X[3]				
2+ - age transient rearing						
Pre-spawning migrant	X[2]				X[1]	
Pre-spawning holding	X					

Source: From Coccoli (2004)
1 Powerdale Dam
2 For winter steelhead only
3 Minimal effect

As presented by Coccoli (2004), the 5 primary limiting factors are those that the EDT model predicted would affect production of one or more life stages of salmonids in the subbasin. These factors, and the potential impact of obstructions, are discussed briefly below.

Channel Stability

The Hood River is a dynamic system that is prone to severe flooding and a variable hydrograph influenced by frequent rain on snow events. Historic land management, including timber harvest and the addition of impervious surfaces, has contributed to the frequency and occurrence of severe flows. The degree of channel stability influences the productivity of many of the earliest life stages for salmonids. For example, the stability of a channel affects the degree of bed scour, which in turn affects incubating eggs and rearing juveniles.

Flow

As with channel stability, flow in the Hood River Basin is extremely dynamic and sometimes volatile. A naturally dynamic hydrograph is exacerbated by increased impervious surface areas and timber harvest. Additionally, summer low flows are exacerbated by irrigation withdrawals, resulting in less available habitat and lower quality habitat for nearly all life stages of salmonid species. However, even given the dynamic flow regime and historic anthropogenic influences, the EDT model determined that these factors did not have a high effect on any given species or life stage (Coccoli 2004). However, ODFW migrant trapping data refutes this statement with respect to fry and juvenile distribution and movement throughout the drainage, and with respect to subbasin smolt production. Flow effects typically ranged from small to moderate for all subject species, with the most effect on juvenile rearing and migrant stages. Adult spawning and holding were also affected to a moderate degree in the model. Regardless of modeling results, flow is an important habitat variable and may have significant impacts to specific lifestages across the subbasin.

Habitat Diversity

In the EDT model, habitat diversity is defined as the effect of the extent of habitat complexity within a stream reach on the survival or performance of the subject species. Essentially, the more diverse the habitat, the greater the chance the species will be successful in that reach. Habitat diversity is a function of gradient, channel confinement, riparian function, and large woody debris. The Hood River EDT determined that while both Chinook and steelhead were affected by habitat diversity as a limiting factor, Chinook were affected to a greater degree and younger life stages were typically affected more than adult life stages.

Sediment Load

The EDT model defines sediment load as the effect on the relative survival or performance of a species related to the amount of fine sediment present in, or passing through, the stream reach. Sediment load affects both turbidity and embeddedness and is naturally high in the Hood River Basin due to glacial melting and associated glacial flour and sand that is transported downstream. This characteristic is thought to contribute to lower salmonid production in the system since perennial streams in the basin fed by glacial melt are typically low in nutrients and have little capacity for supporting large populations of salmonids (O'Toole and ODFWa). High turbidity levels and heavy silt loads are a common occurrence in the mainstem of the Hood River, the Middle and East forks and several tributary systems located in the upper headwaters of the mainstem and Middle and East forks. The loading is exacerbated by high stream gradients that restrict fish movement in the upper reaches (O'Toole and ODFWa).

Based on the EDT reach diagnostic summary (Coccoli 2004), sediment load was a limiting factor in virtually all streams and reaches evaluated. Sediment load, particularly substrate embeddedness, affected all species considered, with the greatest effect on incubating eggs, followed by rearing juvenile life stages. Turbidity was determined to affect adult life stages in some stream reaches, but only to a moderate degree.

Key Habitat Quantity

According to the EDT model, a key habitat is the primary habitat a species uses during a specific life stage. The quantity of a key habitat is the percent of the wetted surface area of the stream channel. For example, the key habitats for adult spawning are pool tails and small cobble riffles whereas pools and glides are the key habitats for age 0 and 1 rearing.

Model results indicate that key habitat quantity is likely the most influential limiting factor in the subbasin. Effects were noted for most life stages of both steelhead and Chinook and were due primarily to a lack of primary pools, pool tails and small cobble riffles, and backwatered areas. Reductions in available key habitat are likely due to decreased amounts of large woody debris and increased channel confinement as a result of timber management, road construction, and channel alteration, including straightening.

Obstructions

Obstructions include physical structures or operations that completely or partially block access to upstream habitats, or entrain juvenile outmigrants in irrigation canals. Culverts, dams and irrigation diversions are located throughout the tributaries to the three forks and the mainstem Hood River. A major obstruction, the Powerdale Dam, has been a major limiting to all salmonids in the mainstem Hood River as it has, and currently continues to impact downstream migrating juveniles and is a partial impediment to upstream migrating adults. Another obstruction, in the form of a natural waterfall created during recent high flow events on the Middle Fork, also blocks, at least partially, passage in that system. Operational practices and/or water regulation (in terms of flow) at Powerdale Dam can delay migration upstream of the dam. Concentrated fish downstream of the dam are more susceptible to predators, fishing, and disease.

Other Factors

Other factors that limit salmonid production in the Hood River Basin include those related to on-going anthropogenic activities including agriculture, forestry, urbanization and hydroelectricity. Dams present in the Hood River Basin delay upstream migration of returning adult salmon and steelhead and may entrain juveniles during their downstream outmigration. Past and present land management practices that reduce instream habitat complexity and access to off-channel habitat include the removal of large wood from the stream channel, altered riparian conditions that reduce large wood recruitment, channel straightening, ditching, and diking. The use of pesticides has resulted in their presence in winter steelhead tributaries, and low pH levels have been recorded in the mainstem Hood River (C. Brun, CTWSR, pers comm.).

APPENDIX E: EXCLUSION BARRIER ALTERNATIVES

The Hood River Production Program Master Plan Update is evaluating alternative sites and methods for broodstock collection and escapement monitoring after the decommissioning of Powerdale Dam. Three areas are being considered to address fisheries management requirements of the HRPP: one site each on the West Fork, Middle Fork, and East Fork Hood River. This memo provides information regarding exclusion barriers that will contribute to the conceptual design and cost-benefit analyses of the trap sites.

Exclusion barriers are designed to block movement of fish. The HRPP project will use an *instream* barrier, typical of projects where barriers are constructed across a river to block upstream movement of invasive species or guide migratory fish to fishways, count stations, or hatcheries. A second type of barrier is a *return flow* barrier, which is designed to exclude fish from man-made conveyance channels that return flow to the stream. Return flow barriers are often used to prevent fish entry to tailraces of off-channel hydropower facilities, water treatment plant outfalls, or irrigation wasteways (BOR 2006).

Two primary categories of exclusion barriers are *velocity barriers* and *picket barriers*. Picket barriers are a subgroup within the larger category of *physical barriers,* which uses a physical component to prevent fish from passing the barrier. Another subgroup of physical barriers is *vertical drop structures*, which use a concrete monolith, rubber dam, or analogous structure to create a head differential exceeding the leaping ability of the target fish species. NMFS guidelines for vertical drop structures suggest the structure extend a minimum of 10 feet above the tailwater elevation of the high design flow. This condition is considered unacceptable for the HRPP and these barriers will not be considered further.

Key features that distinguish velocity barriers and picket barriers are presented in each of the next two subsections.

Velocity Barriers

Velocity barriers create a combination of shallow depth and high velocity conditions that restrict a fish's ability to swim and leap into oncoming flow. A velocity barrier typically consists of a full-spanning concrete *apron* that distributes stream flow evenly across the width of the channel, and a vertical *weir* that is higher than the leaping ability of the target fish species. These features are evident in the photo (Figure 1) of a return flow velocity barrier constructed by the North Santiam Water Control District in 2004.

Figure 1. Velocity barrier for the NSWCD tailrace channel, near Stayton, Oregon.

Design Considerations

The advantages and disadvantages of velocity barriers are (BOR 2006):

Advantages

- Low maintenance
- Debris passes with the flow
- All species and life stages that are weaker swimmers than the target species are excluded.

Disadvantages

- Barriers require significant head
- Performance is dependent on maintaining a minimum head differential across the barrier
- Weir construction will create an upstream impoundment that may increase sediment deposits and reduce channel flood flow capacity.

Design Guidelines

Design guidelines for velocity barriers for anadromous salmonids have been developed by the National Marine Fisheries Service (NMFS 2004). Velocity barrier design guidelines include the following:

- The minimum weir height relative to the maximum apron elevation is 3.5 feet.
- The minimum apron length (extending downstream from base of weir) is 16 feet.
- The minimum apron downstream slope is 16:1 (horizontal:vertical).
- The maximum head over the weir crest is two feet.
- The elevation of the downstream end of the apron shall be greater than the tailrace water surface elevation corresponding to the high design flow.
- Other combinations of weir height and weir crest head may be approved by NOAA Fisheries Hydro Program staff on a site-specific basis.
- The flow over the weir must be fully and continuously vented along the entire length, to allow a fully aerated nappe to develop between the weir crest and the apron.

Velocity Barrier Installations

North Santiam Water Control District Tailrace Barrier

This velocity barrier has a design flow of 1,050 cfs, as set by the maximum diversion rate to the NSWCD hydropower facility. The flow rate was estimated to be 250 cfs on the day the Figure 1 photograph. The weir crest is 120 feet wide, and the crest elevation is approximately 6 feet higher than the pre-construction elevation of the streambed at the barrier. The apron extends 18 feet downstream from the base of the weir, and grouted rip-rap extends an additional 25 feet beyond the toe of the apron to protect against scour. The barrier, installed in late 2003, is reported by NSWCD to have required very little maintenance. On the few occasions that large limbs have hung up on the weir, maintenance personnel were able to wade through the shallow stream conditions to dislodge the limbs using a pike pole (L. Trosi, NSWCD Manager, pers. comm. Aug 16, 2006).

Rapid River Adult Trap Velocity Barrier

This barrier, operated by Idaho Department of Fish and Game on a tributary of the Salmon River, is used to divert upstream migrants into a sorting facility for broodstock collection. This barrier is approximately 50 feet wide to accommodate a design flow of approximately 200 cfs. The downstream edge of the apron sits 2 feet higher than the streambed. Design guidelines included a stipulation that water depth above the apron be less than one-half the height of a fish.

Figure 2. Velocity barrier for the Rapid River Hatchery, near Riggens, Idaho.

Walterville Tailrace Barrier

This barrier is owned and operated by the Eugene Water and Electric Board. The weir is 250 feet long and set at a 30-degree angle to the tailrace channel (in order to achieve the required weir length in relation to the perpendicular width of the tailrace channel). The weir is 3.5 feet high including both a concrete stem wall and an adjustable weir crest. Initial operations revealed that negative pressures forming behind the nappe of a weir were drawing water (and entrained fish) towards the base of the weir; the condition was corrected by adding features that ensure adequate aeration behind the weir nappe.

Picket Barriers

Picket barriers used to exclude upstream fish passage are typically flow-through structures made of closely spaced bars. Other names commonly used for these types of barrier include picket weirs, fish weirs, and bar racks. Picket barriers can be designed as permanent barriers or barriers that are installed and removed on a seasonal basis. Several approaches have been developed for clearing debris that collects at the upstream face of the weir, resulting in generally-recognized categories of picket weir design.

Design Considerations

The advantages and disadvantages of picket barriers, as compared to velocity barriers, are (BOR 2006):

Advantages

- Low head loss under clean conditions
- Can be designed to be installed and removed seasonally
- Functions over a wide range of river stages.

Disadvantages

- Exclude only those fish whose girth is larger than the bar spacing
- Require periodic cleaning and are subject to rapid plugging if exposed to high flow events that transport large debris.

Design Guidelines

Design guidelines for picket barriers for adult anadromous salmonids have been developed by National Marine Fisheries Service (NMFS 2004). Guidelines can be applied to fish species other than adult anadromous salmonids, giving consideration to differences in fish size and behavior. The NMFS picket barrier design guidelines include the following:

- The maximum clear opening between the bars (pickets) is 1 inch.
- Bars shall be flat bars aligned with flow or round tubes aligned in the vertical direction.
- The rack shall have a minimum of 40 percent open area.
- The average design velocity passing the rack should not exceed 1 ft/s for all design flows with a maximum local velocity of 1.25 ft/s, or half the velocity of the adjacent river flow, whichever is less. Velocity is based on the gross submerged area of the bar rack.
- The maximum headloss across the bar rack should be 0.3 ft during operation. The rack should be cleaned if higher headlosses occur.
- The pickets should extend at least 2 ft above the maximum design water elevation.
- A minimum depth of 2 ft shall be maintained at the barrier for at least 10 percent of the river cross section at the barrier.
- Picket barriers should be designed to lead fish to a safe passage route by angling the barrier to the safe passage route, providing sufficient attraction flow at the safe passage entrance, and minimizing false attraction to the picket barrier flow.
- A uniform concrete sill should be provided for anchoring the picket barrier panels.
- Picket barriers shall be structurally designed to withstand high stream flows.

Picket Barrier Types

There are three general approaches in picket barrier design to accommodate high stream flow events and the associated conditions of bedload and debris movement. These approaches are:

- Fixed picket barriers with cleaning devices that aid in removal of accumulated debris

- Fixed picket barriers with gantries to facilitate removal of picket panels prior to storm events
- Bottom-hinged picket panels designed to lay flat under heavy loads, so that bedload and debris can be passed downstream. Once the load is cleared, the panels are raised to an angled position for normal operation. The mechanism that raises and holds the panel in the angled position can include resistance board weirs, hydraulic rams, or pneumatically-controlled floats.

The use of resistance board weirs (RBWs) increased significantly in the past decade, especially in Alaska. The following description by Demko (2001) explains how they work:

> Resistance board weirs are an array of rectangular panels that consist of evenly spaced polyvinyl chloride (PVC) pickets that are aligned parallel to the direction of stream flow. The upstream end of each panel is hinged to a rail that is anchored in the stream bottom, and the downstream end is held at the water surface by a resistance board that planes upward in flowing water. Resistance board weirs are portable and a relatively new alternative to other weirs. They are capable of consistently providing reliable information in streams that experience debris-laden high water periods. Resistance board weirs are more capable than traditional weirs of withstanding high and fluctuating flows, and will temporarily submerge when pressure created by debris loading reaches a point that would wash a traditional weir downstream. Small downstream-floating debris impinged against the weir is removed on a daily basis, whereas most larger debris passes over the weir due to its ability to lie down under pressure. Once the debris passes over the weir it returns to its normal operating position. A small proportion of fish may pass over the weir during brief periods that debris causes it to lay down, but this number can be estimated by marking fish at the weir and later determining the proportion of fish upstream that are unmarked.

Resistance board weirs are generally designed to be a seasonal barrier. Installation procedures typical for Alaska conditions are described by Stewart (2003):

> Work may begin as soon as river conditions allow. Crew must be able to wade the site to work effectively. Drysuits and snorkel gear are used to improve wading capability and complete underwater tasks. This manual defines wading conditions as normal when an individual can reasonably wade a perpendicular course across the channel in a drysuit, and difficult when an individual is not able to wade a perpendicular course but is able to maintain steady contact with the bottom.
>
> The rail must be completely installed before proceeding with installation of panels and other components. Rail installation requires normal wading conditions, but panels can be installed during higher water in difficult wading conditions. For this reason the rail is often installed before the operational period and left installed during the winter months. But because winter and spring ice conditions can be destructive, this strategy only works at sites with moderate coastal winters without thick ice. If normal wading conditions can be anticipated near the beginning of the operational period, the best strategy is to remove the rail after each field season.

Picket Barrier Case Studies

Nimbus Dam Bar Rack

A removable bar rack has been used for many years on the American River, near Sacramento, California to prevent Chinook salmon from reaching Nimbus Dam (Figure 3). The bar rack spans the river and guides upstream migrating salmon to the Nimbus Fish Hatchery. The rack has been an effective fish barrier, but it has also exhibited problems with debris accumulating on the rack during high flow events. Removing the debris and the rack panels is a difficult and costly operation, since the facility does not have a gantry crane or other mechanical system to assist with removal.

Figure 3. Nimbus Dam bar rack barrier, on the American River near Sacramento, California. (Photo source: BOR 2006)

BOR evaluated several alternatives for addressing the O&M issues and has decided to implement the alternative that eliminates the bar rack entirely. Modifications will be made to increase attraction to the hatchery's ladder and trap system. The anticipated increase in attraction, coupled with the fact that existing hatchery returns far surpasses the broodstock collection objective, have virtually eliminated concerns regarding excluding upstream migrants from the tailrace of the dam. The bar rack will be removed within a few years (B. Mefford, BOR Hydraulics Research Engineer, pers. comm. January 24, 2007).

Chiwawa River Picket Weir Modifications

Washington Department of Fish and Wildlife uses a bottom-hinged picket weir to guide upstream migrants into their Chiwawa River fish trap northwest of Wenatchee, Washington. The Chiwawa Valley was formed by glacial activity. The river exhibits classic glacially-driven meandering, causing the river to slow down, deposit sediment, and form extensive gravel bars comprised of silts and gravels. The ability of the river to move extensive bedload makes it extremely dynamic from year to year.

The Chiwawa trap and weir is operated from June 1 to September 1. The period includes the month with the highest mean monthly streamflow during the year (June, at 1,570 cfs) and it terminates during the month with the second lowest mean monthly streamflow (September, at 158 cfs). (Source: USGS Gage No. 12456500, Chiwawa River near Plain, Washington, water years 1911-2005.)

A resistance board weir was installed at the Chiwawa facility in the early 1990s. The weir remained intact through high flow events by collapsing under debris loads as intended (Figure 4), but the frequency and extent of weir down-time generally rendered the barrier ineffective. In 1993 (est.), the resistance board weir was removed and replaced with a bottom-hinged picket weir equipped with a system of hydraulic rams and pressure relief valves (Figure 5). The weir collapses under debris loads the same as with the RBW, but the hydraulic rams facilitate getting the weir raised back to its functional barrier position. Even so, according to the Chiwawa River Spring Chinook HGMP draft (2005), the efficacy of the weir to collect broodstock under moderate to high river flows has been identified as a potential problem. The modified weir has now operated through 13 seasons, and the HGMP reports the mean extraction rate for the weir to be 18% (range 5-40%).

Figure 4. Chiwawa trap resistance board weir circa 1992, near Wenatchee, Washington.

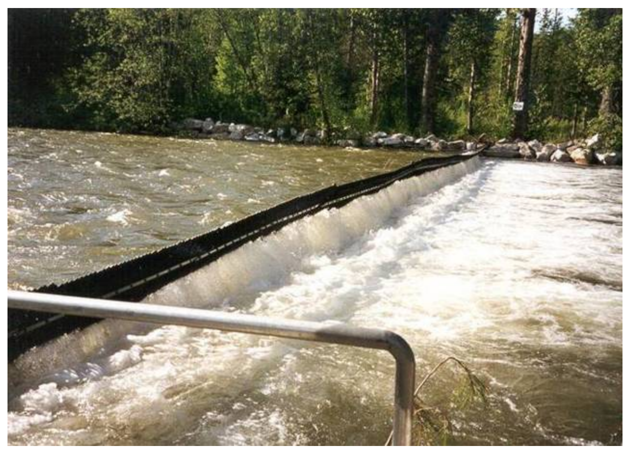


Figure 5. Chiwawa trap modified weir circa 1994, featuring a hydraulic system to raise and lower the weir.

Twisp River Picket Weir Modifications

The Twisp River adult trap is operated by WDFW in the Methow Basin of north central Washington. The facility installs a bottom-hinged picket weir each year to prevent upstream migration of Spring Chinook from May to September. The period includes the months with the highest mean monthly streamflow during the year (June, at 881 cfs) and the lowest mean monthly streamflow (September, at 45 cfs). (Source: USGS Gage No. 12448998, Twisp River near Twisp, Washington, water years 1975-2005.)

The Twisp facility was constructed in 1993 with a resistance board weir spanning the river and an adult trap structure at the left bank. Generally, the RBW functioned in its intended manner. However, dynamic changes in the river's geomorphology affected the weir's ability to operate effectively during low flow regimes. Rising stream bed conditions did not allow the RBW to slope downward during low flow periods, causing kelts and fallback fish to be stranded on the pickets.

Figure 6. Twisp trap resistance board weir circa 2004.

In 2005, the facility was modified in the following ways:

- The existing weir panels were retrofitted with a float system. A pneumatic control system can add air to the floats to raise the panels. Conversely, it can rapidly deflate the floats to lower the weir and wash off stranded debris or fish.
- Weights were added to ensure the picket panel assembly can be fully submerged.
- The shoreline trap was replaced with a picket trap located in deeper water more towards the center of the channel.
- A removable gangway was developed for trap access.
- A floating boom was added to deflect debris past the trap and gangway.

The modified weir and trap operated through the 2006 season with improved performance, and the facility withstood a storm event of 2,400 cfs.

Figure 7. Twisp trap and its modified floating weir in 2006, near Twisp, Washington.

Figure 8. Twisp trap during a 2,400 cfs flow event in 2006.

Lookingglass Hatchery Picket Barrier Modifications

The Lookingglass Hatchery is located in northeast Oregon just north of Elgin, approximately two miles upstream of the confluence of Lookingglass Creek and the Grande Ronde River. This reach of Lookinglass Creek is in a relatively steep valley containing intermittent large boulders, and it exhibits definitive stream course shifts.

The hatchery installs a barrier in May each year and operates it through September, in order to divert upstream migrants into the hatchery for selection of spring Chinook broodstock. The period includes the month with the highest mean monthly streamflow during the year (May, at 367 cfs) as well as the month with the lowest mean monthly streamflow (September, at 52 cfs). (Source: USGS Gage No. 13324300, Lookingglass Creek near Lookingglass, Oregon, water years 1982-2005.)

According to Bob Lund, Lookingglass Hatchery Manager, the Lookingglass resistance board weir functioned well, but only within a specific range of flows. The limiting factor at this facility was extreme low flow, during which the boards were collapsed and laying flat, therefore preventing capture of all species. Due to the on-going low summer flows in this system, the resistance board weir was replaced in 2006 with a vertical picket weir that is installed and removed annually.

Figure 9. Lookingglass Hatchery resistance board weir circa 1985, near Elgin, Oregon.

Stanislaus River Resistance Board Weir

The Stanislaus River is located in the Central Valley of California and is one of the largest tributaries to the San Joaquin River. In 2002, fisheries researchers began using a resistance board weir from September through mid-April at river mile 31.4 near the town of Riverbank. The barrier is part of a monitoring program used to determine the total Chinook salmon and steelhead escapement and timing in the Stanislaus River, and it serves as a measure of accuracy of traditional carcass survey estimates in the Stanislaus River and on other Central Valley tributaries.

The Stanislaus River RBW was designed and installed based on guidelines developed by the Alaska Department of Fish and Game (Stewart 2002, 2003). The weir includes design features to accommodate passage of both motorized and non-motorized boats, and a safety plan was developed to identify safety guidelines for weir operators and members of the public who may encounter the structure. An upstream live trap is located at one end of the weir, accommodating observation through real-time observation from above; video monitoring; or temporary holding in the trap for subsequent handling and sampling.

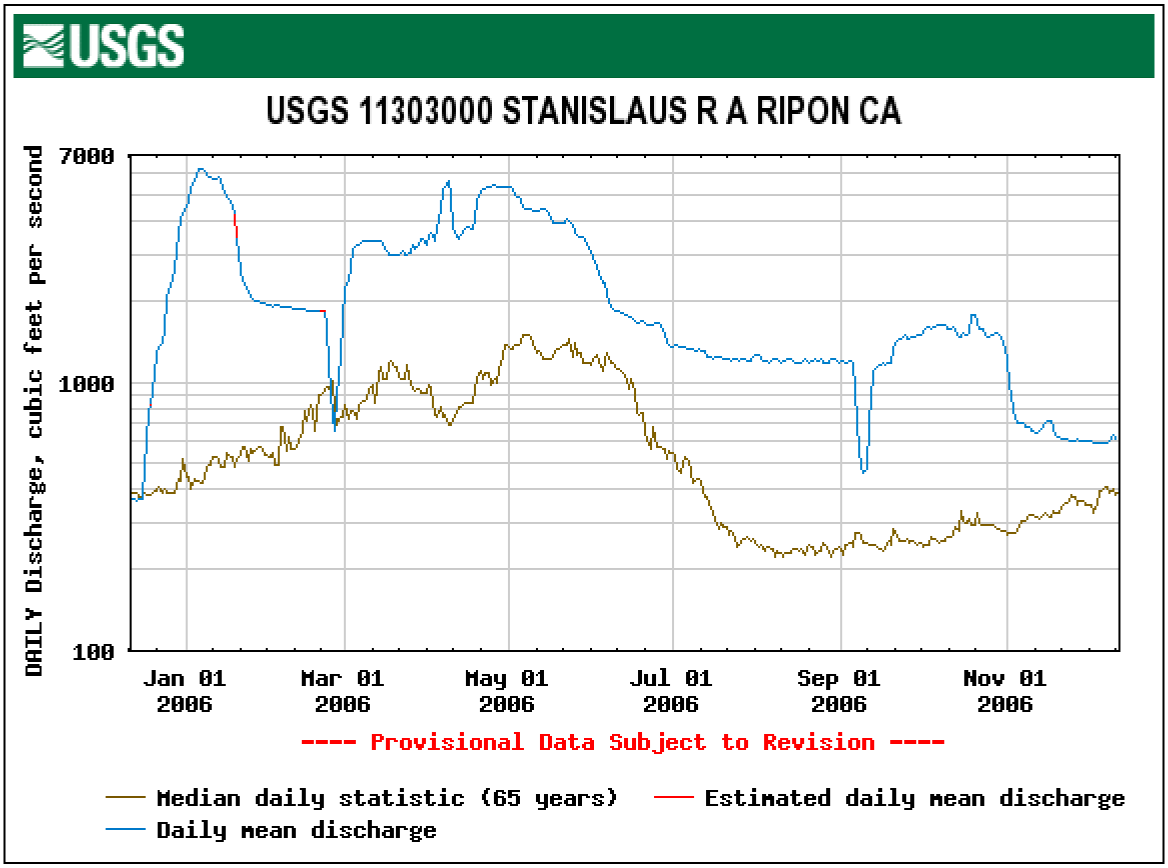
Figure 10. Stanislaus River upstream live trap and RBW panels prior to installation.

Figure 11. Aluminum boat passing over the Stanislaus River weir.

Flows in the Stanislaus River are highly regulated by reservoirs and power plants in higher portions the basin. The months spanning weir operations include the month with the second highest mean monthly streamflow during the year (April, at 1,523 cfs) and the month with the lowest mean monthly streamflow (September, at 330 cfs). (Source: USGS Gage No. 11303000, Stanislaus River at Ripon, California, water years 1941-1997.)

High flows during the 2005-2006 monitoring season allowed operators to determine approximately 1,200 cfs is the maximum flow that the weir can sample effectively without requiring 24-hour maintenance to keep it afloat. When flows increase above 1,500 cfs, the weir is collapsed by flattening the resistance boards and removing barrels that have been placed under panels to aid in floatation at higher flows. Collapsing the weir will likely prevent it from blowing out.

Extended high flows from mid-December 2005 through February 2006 resulted in the monitoring season being severely truncated; the last day of weir sampling occurred December 19, 2005, approximately half way through the normal operating season. In late February, operators were notified in advance that flows at Goodwin Dam were going to be reduced to 350 cfs for a short, two-day period (February 23–25). During this brief flow reduction, weir technicians were able to access and remove the weir in its entirety. Most of the weir components were recovered in good condition and were expected to be reusable in subsequent seasons.



Asotin Creek Resistance Board Weir

Washington Department of Fish and Wildlife is using a resistance board weir in conjunction with two live traps to monitor fish populations in the Asotin Creek watershed of southeastern Washington. One trap is used to capture adult pre-spawners and the second trap is used to capture post-spawned steelhead (kelts). The RBW was first used in 2004, with the main trapping season spanning from mid-December of 2004 to July of 2005. However, the traps were also operated at other times of the year to help establish a baseline of adult salmonid spawning patterns. When not in use, sections of the adult trap are disabled to allow unrestricted passage. When the adult trap was operating, the trap operated 24-hours a day and was checked once or more daily, depending on stream flow, debris, or number of fish present (Mayer et al. 2006).

It is reported that both the resistance board weir and trap have held up well through conditions of both high flows and icing (Figure 12). Photographs of the weir suggest portions of the weir may become dewatered during low flow conditions (Figure 13), although operation of the downstream migrant live trap may reduce the incidence of downstream passage over the weir. Median daily statistics for fourteen years of gage data indicate mean daily discharges in Asotin Creek are generally no higher than approximately 200 cfs (see Appendix A).

Figure 12. Asotin trap under high water conditions.

Figure 13. Asotin trap under normal operating conditions.

Recommendations for the Hood River Basin

- Velocity barriers should be considered only at the Moving Falls site, where there is sufficient natural head differential across the site to accommodate requirements without significant impoundments.
- Fixed picket barriers are likely to suffer damage from sudden storm events and associated movement of large bedload and debris.
- Resistance board weirs or bottom-hinged picket barriers appear to be the most practical response to concerns regarding debris damage.

Alternative broodstock

Although the construction of permanent barriers such as velocity barriers equipped with trapping facilities may represent the most effective way to capture broodstock and enumerate escapement, such facilities are costly, particularly during the design and construction phases. Alternately, presented herein are low cost approaches for collecting adults for broodstock and monitoring.

Fishing

Gill or Trammel Netting

Gill or trammel nets have been successfully used to capture broodstock and should be considered. A trammel net consists of three layers of cotton or nylon net panels suspended vertically from a single float line by attaching the panels to a single lead line along the net bottom. Two large-mesh outer panels encase a fine-mesh inner panel. The inner panel is longer and hangs loosely between the outer panels, forming a bag or soft pocket of netting (Murray 1983). The bag allows fish to be entangled rather than strangled (e.g. gilled), minimizing stress and injury (NOAA Fisheries 2003).

Fish captured in trammel nets generally remain in better physical condition than those captured in gill nets (NOAA Fisheries 2003). With trammel nets, loose panels of soft netting wrap around a fish minimizing the chaffing and entanglement of body parts (Murray 1983). Fish sampling studies conducted in northern California by the California Department of Water Resources have resulted in the capture of adult salmonids in trammel nets with average injury rates below 5% and mortality rates below 3% (as cited in NOAA 2003).

Gill nets capture fish that swim partway through the net and are unable to back out because they become entangled by their teeth, operculum, or fins (Murray 1983; ODFW 1996). Of three gill net mesh sizes used to capture adult Chinook salmon in Alaska, the larger mesh (8-inch) was most effective at capturing large salmon, but was more harmful to fish than the smallest mesh size (5 1/8-inch). Most fish captured in the 5 1/8-inch mesh gill nets were entangled rather than gilled (ODFW 1996). Due to the potential for gilling and entanglement, NOAA Fisheries has stated that salmon captured in gill nets will be more adversely affected than fish captured in trammel nets. However, if nets are frequently inspected, this effect is minimized.

Compared to hook and line angling, the use of such nets is more efficient during the trapping period; however, such nets may increase the potential for stress or mortality, potentially affecting reproductive performance. Keyvanfar and Khanipour (1999) advocate use of trammel nets versus gill nets to catch broodstock for aquaculture as fish are less stressed. The effect of using such nets in ESA-listed steelhead habitat would have to be considered by HRPP co-managers as there may be restrictions on the use of such equipment for broodstock collection.

Hook and Line

It is possible to obtain broodstock through hook and line angling, using Tribal or recreational fishers in the area. This method would be economical; however, efficiencies would not approach that of a fixed velocity barrier trapping structure. Additionally, this method may be stressful to individuals and may lead to mortality or poor reproductive performance.

Some species may be more susceptible than others to hook and line angling, and within a species, individual fish may exhibit varying degrees of hook-and-line vulnerability. Individuality of angling vulnerability has been shown for rainbow trout. Lewynsky (1986) observed that during a nine-week raceway fishing trial, captures ranged from zero to five times per individual trout. About 37% of the fish were caught more than once, and 21% were never captured. This and other studies on largemouth bass (Burkett et al. 1986; Hackney and Linkous 1978) indicate that some individual fish may be more likely than others to be caught by hook-and-line methods. Other studies of rainbow trout (Dwyer and Piper 1984; Brauhn and Kincaid 1982; Moring 1982; Hudy and Berry 1983) indicate that vulnerability to angling may be heritable. If this trait is heritable in some species, collection of broodstock by this method may skew the genetic composition of the brood toward those fish that are more vulnerable to angling. Additionally, because steelhead are relatively difficult to catch (5 to 8 hours per fish), this method may be less successful depending on the target species.

Fish wheels

Fish wheels have been used in countries all over the world to collect fish for a variety of purposes. This technology was in use in the Columbia River drainage by 1879 and has proven particularly effective on large, turbid river systems. Fish wheels consist of two large baskets that turn on an axle (see Figures 14 - 16). They are rotated by the river current and scoop up passing fish, primarily adults as they migrate upstream. Captured fish slide down a chute into a holding box that is emptied several times a day. The structures are either anchored in place at the side of the river or fastened to posts driven down into the riverbed. Research-based fish wheels have a water-filled box that holds fish unharmed until they can be measured and released to continue their upstream migration.

Daum (2005) used an event-triggered video system to record fish during capture to eliminate the handling and holding associated with fish wheel live-boxes. In his study, a magnetic switch was connected to an exit door installed in the fish wheel chute that signaled a computer to videotape passing fish. Reliability and accuracy were evaluated over a 3-year period, during which the system failed only once due to a malfunction of the exit door. Compared with continuous time-lapse recordings, the video system missed 1% of captured fish, mostly small species that passed under the exit door without activating the switch. According to the study, the advantages of the switch-triggered video system over traditional fish wheels with live-boxes included reduced handling and holding time for captured fish; improved counting accuracy; unattended operation; and lower labor costs.

A Portland-based company named "Salmonsoft" has developed software called "FishTick." FishTick is a computerized video system that allows fisheries biologists to enumerate fish passage at weirs and dams. FishTick consists of two programs. The first program, FishCap (for Fish Capture), detects fish and writes the frames containing fish to a video file. The second program, FishRev (Fish Review), allows the user to review the video file captured by FishCap. The user can scan through the file of fish frames to identify the species and place data into a customizable Excel spreadsheet. Users of the FishTick software include the United States Fish and Wildlife Service (USFWS) in Alaska. Salmonsoft customized FishTick for use with Alaskan fish wheels currently operated in the Yukon River by USFWS, the Alaska Department of Fish and Game and the Bering Sea Fisherman's Association.

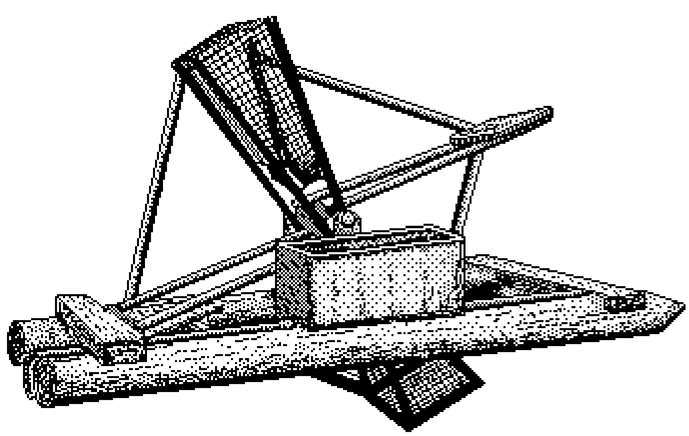


Figure 14. Fish wheel schematic.

Figure 15. Fish wheel.

Figure 16. Wooden fish wheel.

Trap with Guide Nets

In impoundments and river sections where the velocity of flow is minimal "Merwin Traps" are used. These consist of a floating unit made up of netting with attached leader nets extending to the shore (Figure 17). In the vicinity of the trap unit this leader net incorporates a number of guiding vane nets at each side that ensure that fish that come up against the net and travel along it seeking a route past will be guided into the trap. The arrangement of these guide nets is also such as to prevent the fish from escaping once they have entered the trap. Merwin Traps are typically employed in impoundments and stretches of river where the velocity of flow is minimal; therefore, this trapping system may not be viable in the Hood River. It may be possible to use a trap placed in the thalweg without the associated leader nets; however, trap efficiency may be too poor to make this a viable option.

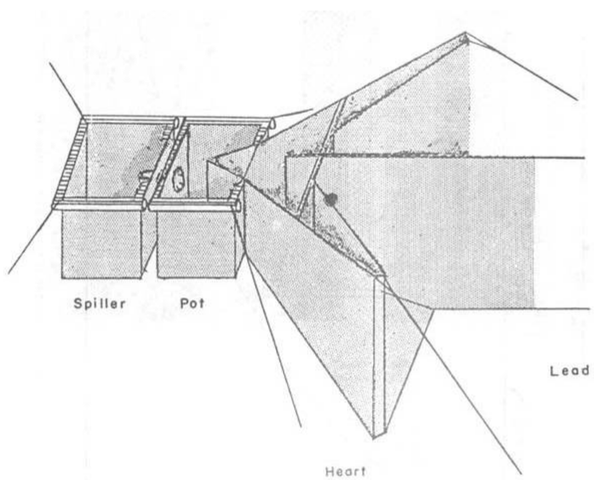


Figure 17. Schematic of a Merwin Trap (as cited by Raymond and Collins 1975)

Picket Weir Using Tripods

The Imnaha Satellite Facility, located along the Imnaha River in northeast Oregon employs a portable picket weir to block upstream passage. The pickets are attached to a permanent concrete sill using tripods that are installed annually (see Figure 18). Although this system works effectively to direct fish into a ladder for collection, it is only operational when flows are less than about 1,000 cfs. Flows above that threshold are considered too dangerous to install the system and therefore early portions of the spring Chinook run are not captured. The maximum operational flow is relative to the subject river system and installation safety concerns and trapping efficiencies should be estimated on a case by case basis.

A modified version of the Imnaha system could potentially be used in the Hood River, although flows are likely too high during portions of the trapping season to allow safe usage of such a system throughout the year. The portable tripods could be anchored along the streambed, although a level grade provided by a concrete sill is preferable. If streambed installation is viable, the pickets could be arranged in a manner to guide fish to a trap box. The trap could be placed such that a relatively high proportion of the total flow can be screened through the trap in order to achieve the highest trap efficiency. The requirement for adequate velocity, depth, and trap efficiency usually argues for placing the trap in the thalweg of the channel. This trap could be accessed by a portable walkway that is anchored to the bank and sits atop the trap box. Such a structure would be portable, resulting in less cost but more labor during annual installation and operation. The trap would likely need to be checked at least every 24 hours at a minimum to avoid migratory delay that would represent take of listed steelhead and/or bull trout.

Figure 18. Imnaha Satellite Facility Picket Weir Using Tripods Atop Concrete Sill.

Picket Weir Attached to Fixed Cable

The Lostine River Satellite Facility adult trap employs a picket weir that is raised and lowered using a cable-wench system operated by a fixed tow-truck (Figures 19 - 21). Upstream migrants are directed into a plywood fish trap on the right bank. The picket weir is anchored to the river substrate using buried metal gabions. The pickets remain in the river year-round and are raised during trapping periods (May – October). This system is effective for fishing in flows up to 1,200 cfs. Flows above that threshold prohibit safe operation of the weir, which results in a trapping facility that misses the early portion of the spring Chinook run.

Figure 19. Lostine River Satellite Facility Temporary Picket Weir Raised During Operations.

Figure 20. Lostine Satellite Facility Picket Weir During Non-Operational Periods.

Figure 21. Tow-Truck Cable System.

Summary

Capital cost associated with temporary structures is significantly less than that of more permanent facilities; however, there is a continuing expense associated with annual erection and dismantling. In some cases a boat may be necessary to enable installation or servicing. A full-time crew may be required for servicing and fishing while gear is in operation. Maintenance of netting, if a component of the trap, can be problematic in locations where flows and velocities are high. Additionally, if there is not a complete barrier to upstream migrations, use of some of the techniques discussed above will capture and sample only a portion of the fish population, and that proportion may be largely unknown if not coupled with comparative studies using downstream angling to estimate escapement.

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Personal Communication

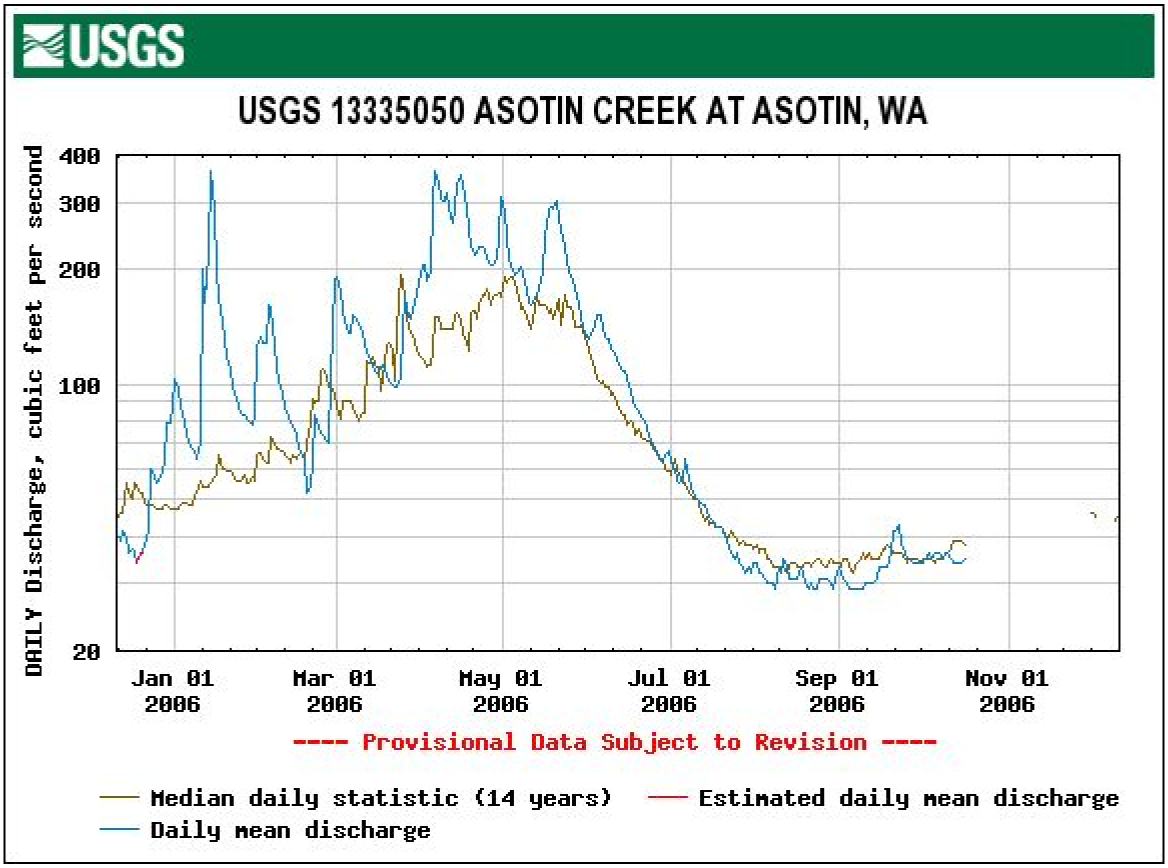
B. Mefford, BOR Hydraulics Research Engineer, pers. comm. January 24, 2007.

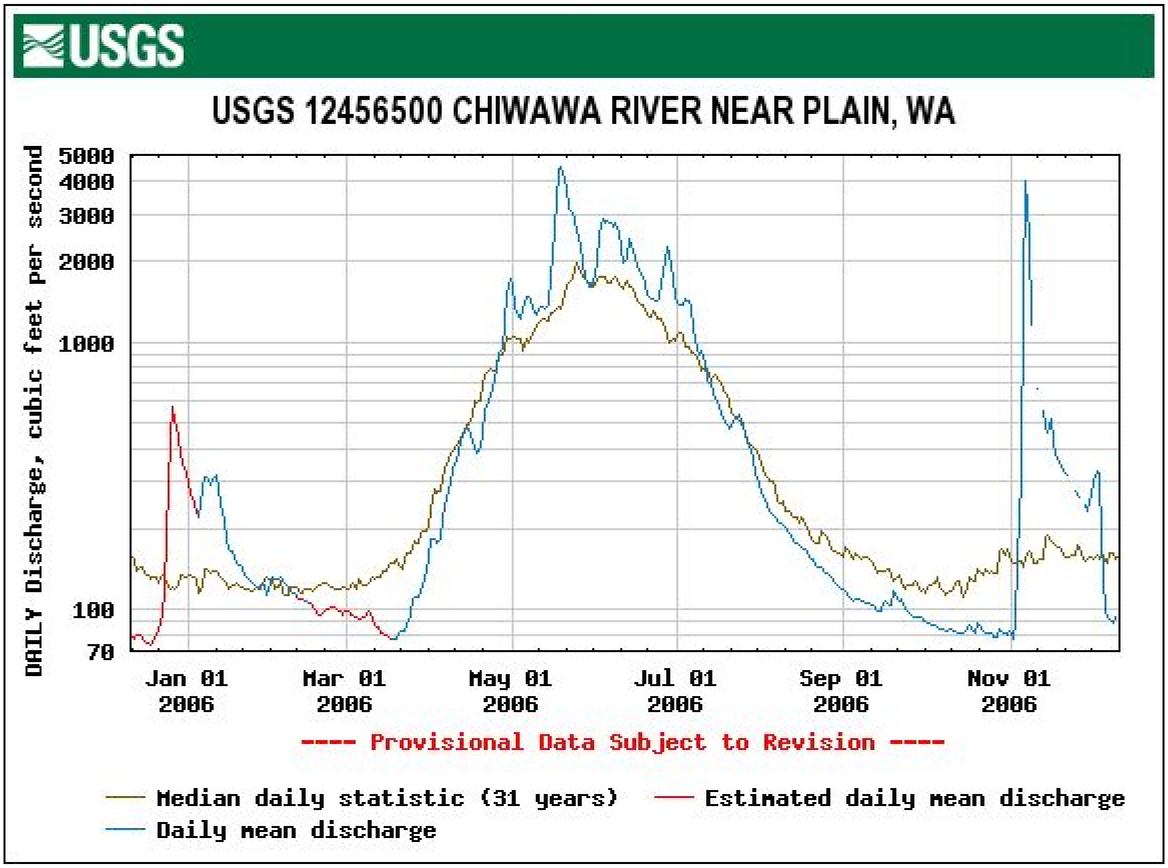
L. Trosi, NSWCD Manager, pers. comm. Aug 16, 2006.

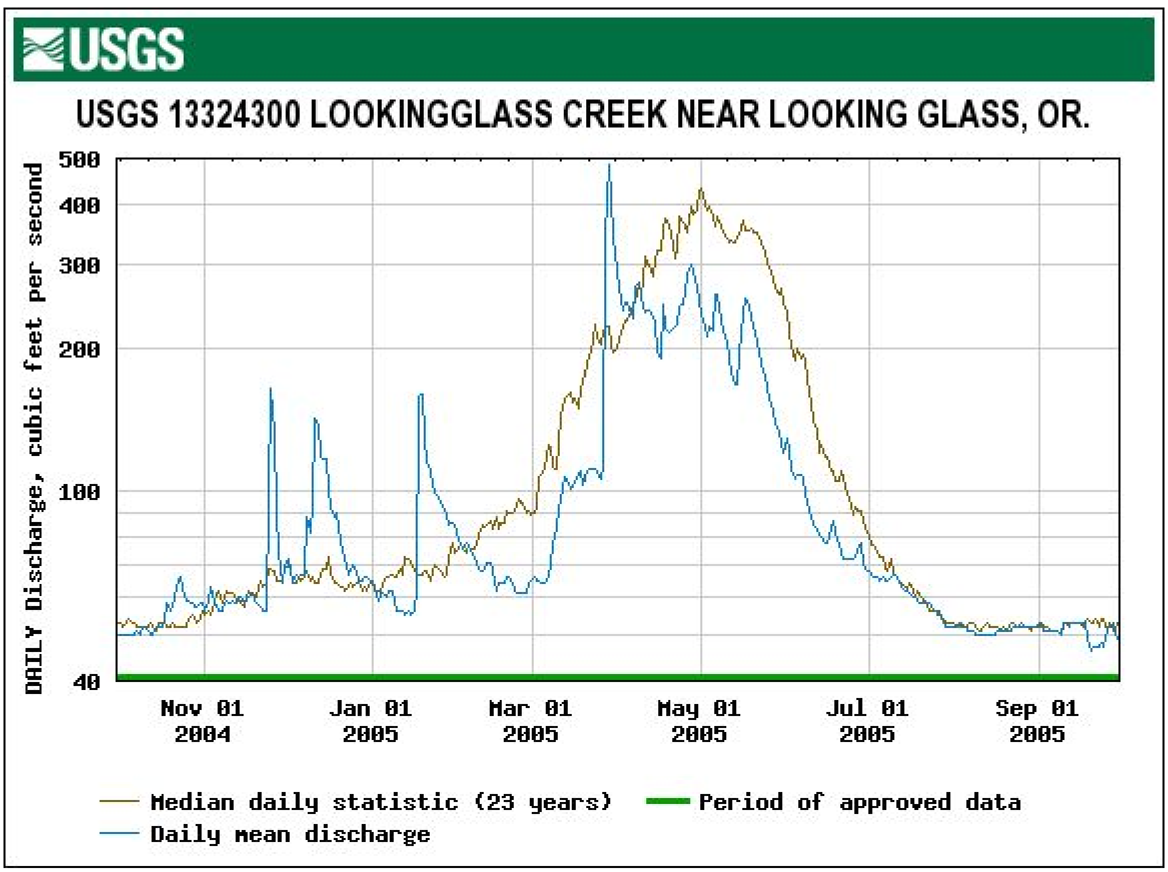
B. Lund, ODFW Lookingglass Hatchery Manager, pers. comm. October 15, 2006

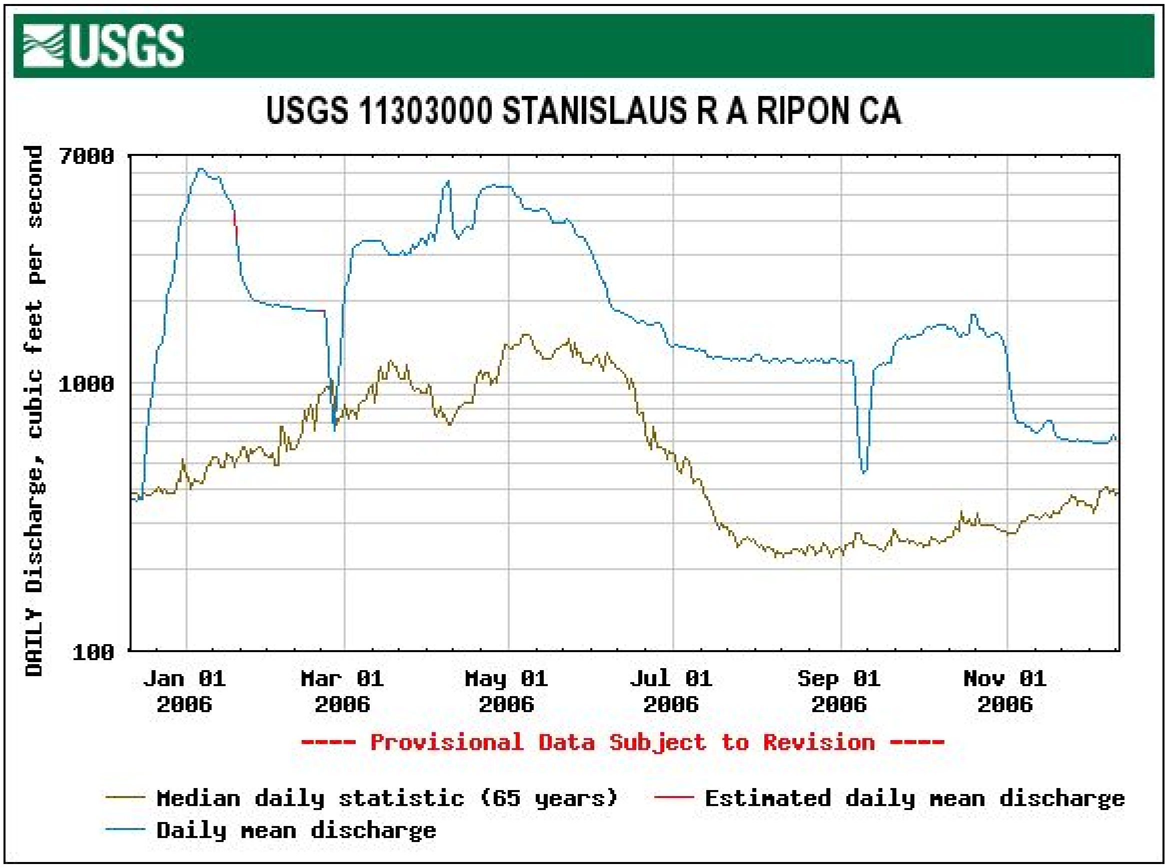
Appendix A

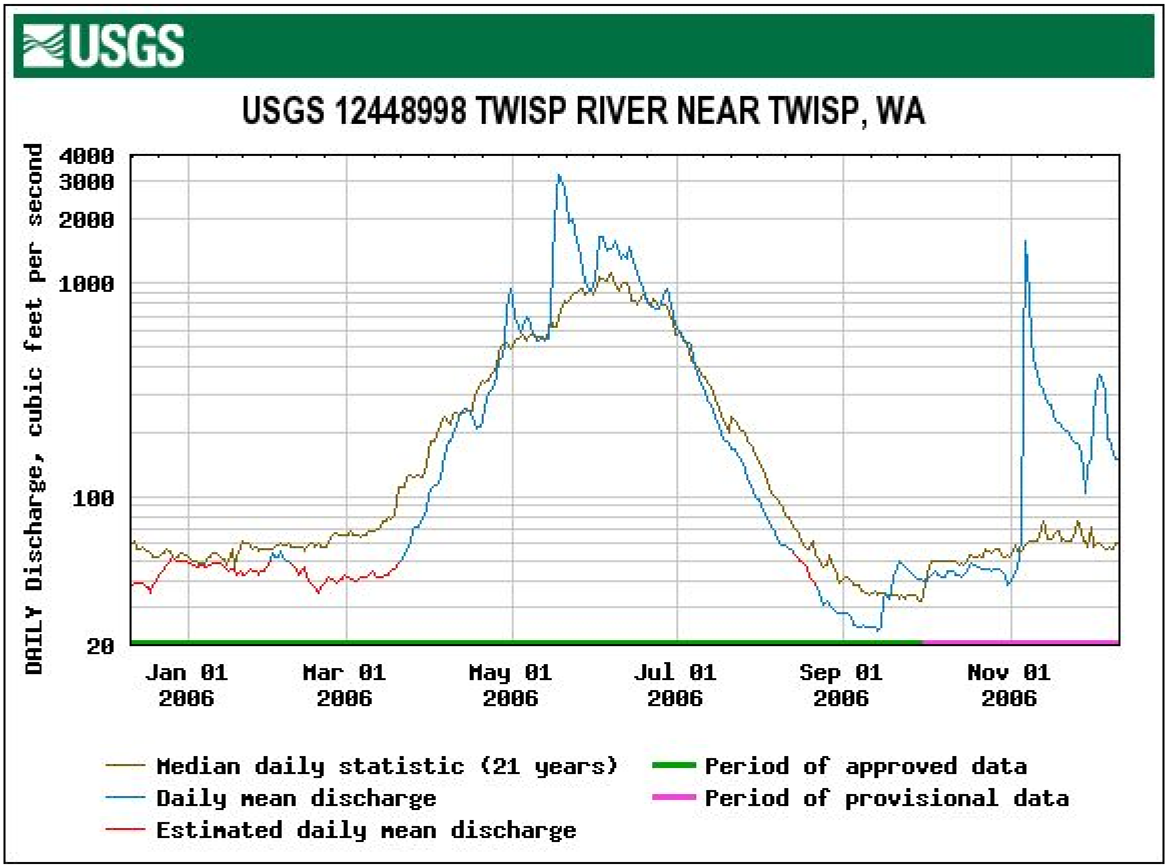
Daily Mean Discharge Data for Case Study Sites and for Hood River Gage Sites

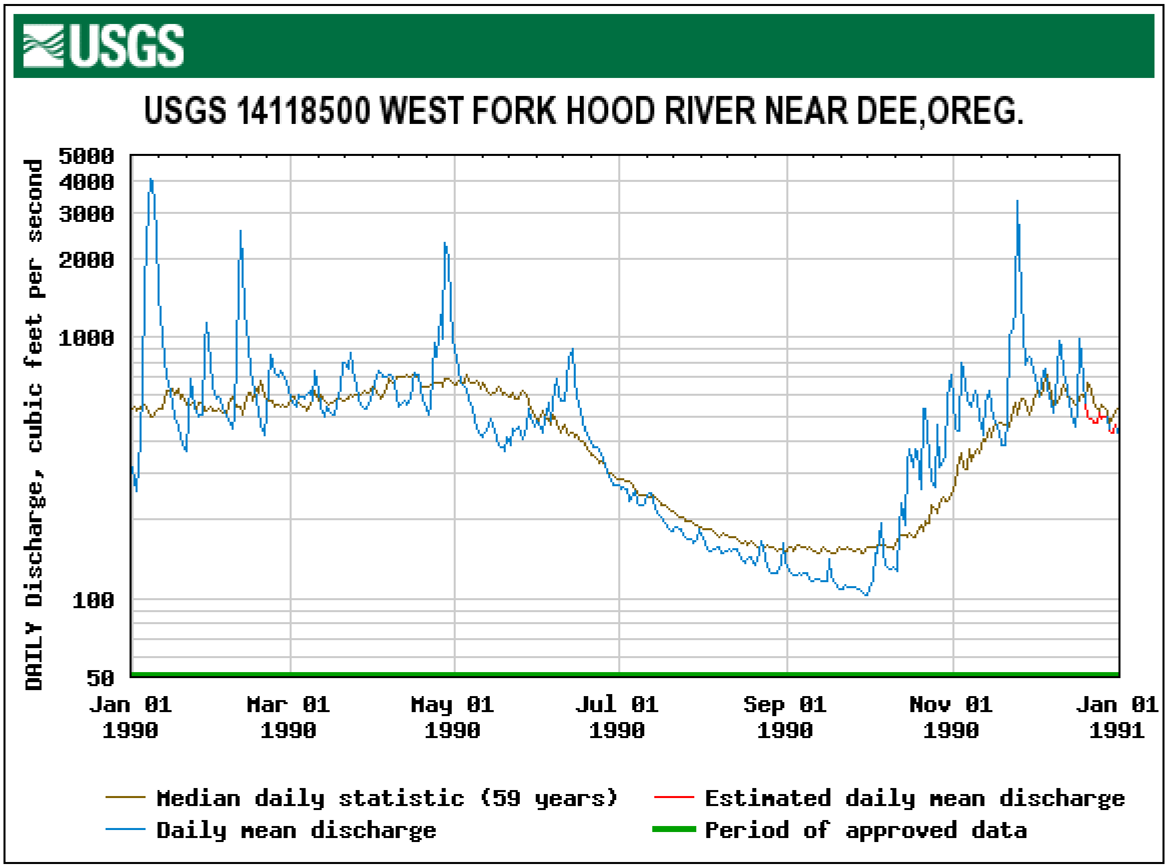



USGS
USGS 12456500 CHIWAWA RIVER NEAR PLAIN, WA
DAILY Discharge, cubic feet per second
5000
4000
3000
2000
1000
100
70
Jan 01 2006
Mar 01 2006
May 01 2006
Jul 01 2006
Sep 01 2006
Nov 01 2006
---- Provisional Data Subject to Revision ----
Median daily statistic (31 years)
Estimated daily mean discharge
Daily mean discharge


USGS
USGS 13324300 LOOKINGGLASS CREEK NEAR LOOKING GLASS, OR.
DAILY Discharge, cubic feet per second
500
400
300
200
100
40
Nov 01 2004
Jan 01 2005
Mar 01 2005
May 01 2005
Jul 01 2005
Sep 01 2005
Median daily statistic (23 years)
Period of approved data
Daily mean discharge


USGS
USGS 11303000 STANISLAUS R A RIPON CA
DAILY Discharge, cubic feet per second
7000
1000
100
Jan 01 2006
Mar 01 2006
May 01 2006
Jul 01 2006
Sep 01 2006
Nov 01 2006
---- Provisional Data Subject to Revision ----
Median daily statistic (65 years)
Estimated daily mean discharge
Daily mean discharge


USGS
USGS 12448998 TWISP RIVER NEAR TWISP, WA
DAILY Discharge, cubic feet per second
4000
3000
2000
1000
100
20
Jan 01 2006
Mar 01 2006
May 01 2006
Jul 01 2006
Sep 01 2006
Nov 01 2006
Median daily statistic (21 years)
Period of approved data
Daily mean discharge
Period of provisional data
Estimated daily mean discharge


USGS
USGS 14118500 WEST FORK HOOD RIVER NEAR DEE,OREG.
DAILY Discharge, cubic feet per second
5000
4000
3000
2000
1000
100
50
Jan 01 1990
Mar 01 1990
May 01 1990
Jul 01 1990
Sep 01 1990
Nov 01 1990
Jan 01 1991
Median daily statistic (59 years)
Daily mean discharge
Estimated daily mean discharge
Period of approved data

APPENDIX F: PARTICLE ANALYSIS

EAST FORK HOOD RIVER AT GRAVEL PIT
Concept Level Evaluation of Particle Movement
Prepared: M. Garello P.E.
Date: 06.25.07

Description: This spreadsheet calculates the size of particle mobilized over a range of known hydraulic conditions. Current information regarding particle embedment is unknown. Therefore the Shield's Parameter is assumed to range from 0.3 to 0.45. This information will be used to evaluate basic particle mobility thresholds under expected operating conditions.

METHODS: Use Shield's Equation for incipient motion of particles. Assume movement of median particle size when boundary stress / critical shear stress is equal to 1. Assume complete mobilization of median particle size when boundary stress / critical shear stress is equal to 2.
Elliot, John G. 2002. Bed-Material Entrainment Potential, Roaring Fork River at Basalt, Colorado. US Geological Survey Water Resources Investigations Report 02-4223

Critical shear stress is expressed as:

$$\tau_C = \tau_C^*(\gamma_S - \gamma_W)D_{50}$$

where,

τ_C = critical shear stressl, lb/ft^2
τ^*_C = Shield's parameter at critical point of motion, unitless
D_{50} = median particle diameter being mobilized, ft
γ_w = specific weight of water, assume 62.4 lb/ft^3 at 20^O C
γ_s = specific weight of stone, assume 165 lb/ft^3

Boundary shear stress is expressed as:

$$\tau_O = \gamma_w H_o S_o$$

where, τ_o = boundary shear stress, lb/ft^2
H_c = critical depth of flow, ft
S_o = average energy gradient, assume equal to water slope, ft/ft

USER INPUT:

Stream Gradient, S_0 = 0.02 ft/ft
Shield's Parameter = 0.03

Table 1. Summary of site hydraulics.

Flood Recurrence	Discharge	Velocity	Average Depth, H_C (ft)
yr	cfs	ft/s	ft
1.0	600	7.4	3.2
2.0	2220	12.5	5.9
5.0	3480	14.6	7.8
10.0	4430	15.8	9.0
25.0	5730	17.2	10.6
50.0	6700	18.2	11.8
100.0	7900	19.1	12.9

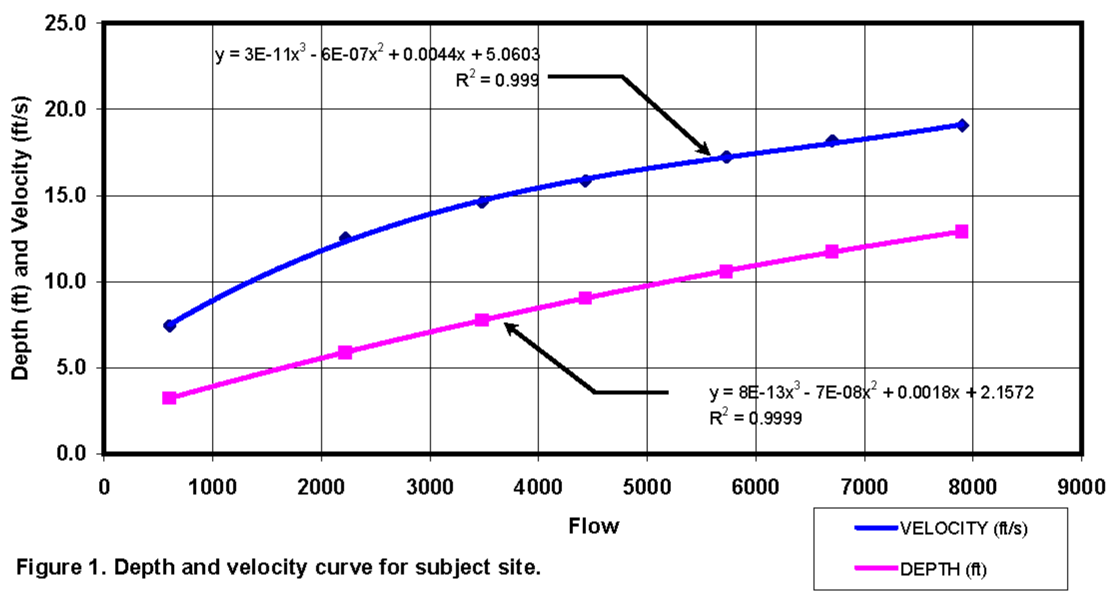


Figure 1. Depth and velocity curve for subject site.

OUTPUT:

Table 2. Summary of results.

Boundary Shear Stress	Partially Mobilized	Fully Mobilized
ft/sqft	ft	ft
4.032	1.30	0.6
7.351	2.30	1.1
9.709	3.10	1.5
11.282	3.60	1.8
13.216	4.20	2.1
14.664	4.70	2.3
16.099	5.20	2.6

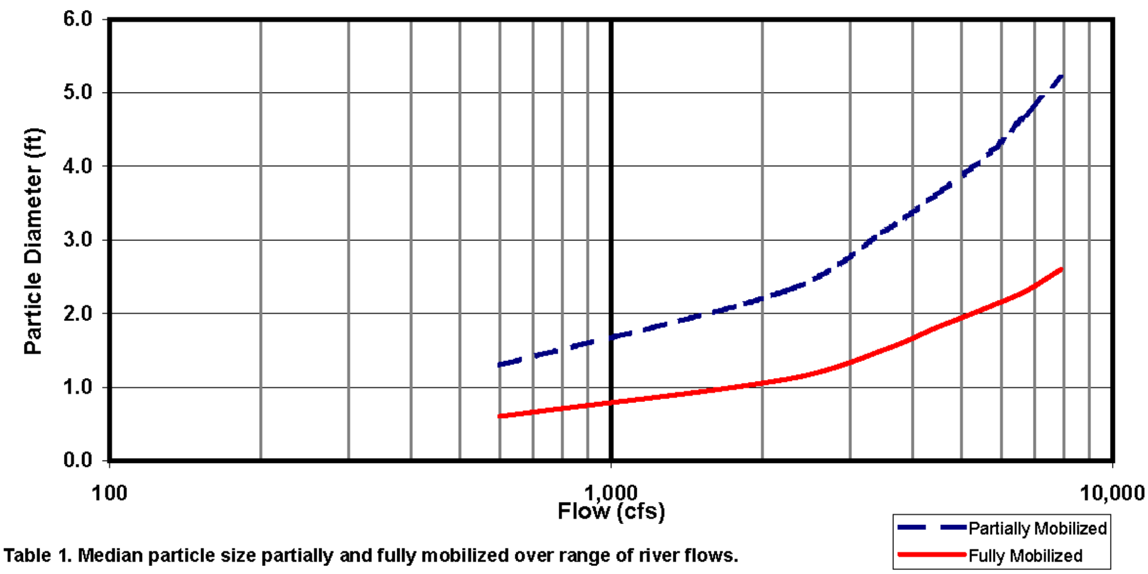


Table 1. Median particle size partially and fully mobilized over range of river flows.

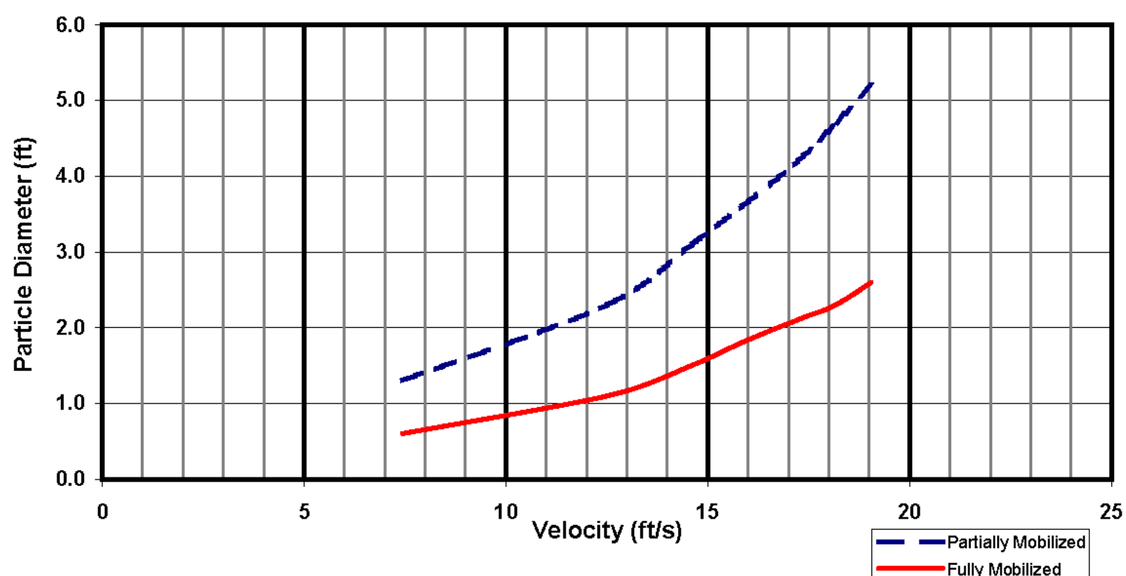


Table 2. Median particle size partially and fully mobilized over range of velocity.

APPENDIX G: WELL TEST

HDR | ONE COMPANY *Many Solutions*℠

Memo

To:	Sarah Branum, BPA, Jim Gidley, PFF Manager		
From:	Joe Miller	Project:	Parkdale Fish Facility Pump Test
CC:	Keith Underwood, Sharon Sawdey		
Date:	8 February 2007	Job No:	37863

Objectives

As part of the Bonneville Power Administration's (BPA) revised Hood River Master Plan, the Confederated Tribes of the Warm Springs Reservation (CTWSR) Parkdale Fish Facility (PFF) is seeking to augment the flow and temperature of their surface water sources by developing a new groundwater source. Two test wells (TW-1 and TW-2), drilled in October 2003, were pump-tested in January 2007 to determine sustainable yield and temperature.

This report documents the testing methods and results of the two pump tests, designed to estimate the sustainable yield for each well pumped separately. The goal of the test is to determine which well is better suited for development. Conclusions of these tests cannot be applied to the pumping of both wells simultaneously, nor the exact degree of potential impact to the yield of adjacent groundwater users resulting from the possible influence created by the pumping of these wells.

Site Description

The Parkdale Fish Facility, located in Parkdale, Oregon (T1N, R10E, S31), is currently used for holding, spawning, incubation and acclimation activities of spring Chinook, summer steelhead and winter steelhead. The spawning building consists of a spawning room, an incubation room, a walk-in cooler and storage rooms. Two adult holding ponds and two acclimation raceways are located adjacent to the spawning building. Support buildings at the facility include a service building (with seasonal staff quarters), maintenance shop, and three residences. A small hydropower facility owned and operated by the Middle Fork Irrigation District is located at the southeast corner of the PFF site.

The PFF's current water supply comes from the Middle Fork Irrigation District Powerhouse No. 3 and Rogers Creek, tributaries of the Middle Fork Hood River. The PFF has a 1997 water right (permit number s53484) for 5.59 cfs (2,509 gpm) from these combined sources.

There are currently three domestic water supply wells for the hatchery residences on the PFF site; a 150 gpm well (DW-1), a 60 gpm well (DW-2), and a 150 gpm well (DW-3), as depicted in Figure 1. Presently these wells are used for domestic water service although potential hatchery use out of DW-1 is considered. In addition, MK Drilling drilled and installed two additional wells for potential production and use at the facility, known as test wells 1 and 2 (TW-1 and TW-2). The BPA does not currently hold groundwater rights for process water at the PFF; however, an application has recently been submitted on behalf of the CTWSR (C. Brun, CTWSR, pers comm.).

Figure 1

Well description and locations

A summary of the general characteristics for each well cited in this report is shown in **table 1**. Cuttings from both TW-1 and TW-2 show several distinct layers of sand, gravels and boulders to 110 and 140 feet below the casing rim, respectively. Below these depths, TW-1 has mixed gravels and andecite layers and TW-2 has several basalt and andecite layers.

Currently, three domestic supply wells are used at the PFF. Domestic well 1 (DW-1) had static water levels at the beginning of each test within 3 feet of the surface. Water levels in DW-1 were recorded during both pump tests. The second domestic supply well, DW-2, had water levels at the casing rim at the start of the test. No data was collected in this well during the pump test because the measuring tape became hung up at eight feet inside the well. The third domestic well, DW-3, was not monitored during these pump tests and is included for reference purposes only. None of these wells have water rights associated with them.

An off-site well (SW-1), owned by Jack Sanders and located approximately 600 feet southwest of TW-1, was monitored during each pump test (SW-1). This well is used for domestic purposes and is exempt from requiring a water right. At the start of each pump test, SW-1 had a static water level of about 6.5 feet below land surface. A 2002 GeoEngineers report estimates a pump depth of about 23 feet. The Jack Sanders property has two surface water rights with 1989 priority dates from the Middle Fork Hood River for recreational uses.

Table 1. Well Summaries							
Water Source	**Well ID**	**Well Depth (feet below casing rim)**	**Well Diameter**	**Water Bearing Zone**	**Static Water Level**	**Casing (Screened)**	**Year Developed**
DW-1	L16334	100	6-inch	95-100	2.5	0-94 (95-100)	1997
DW-2	L16333	165	6-inch	150-165	0	0-159 (160-165)	1997
DW-2	L61557	165	6-inch	73-165	23	0-120 (not screened	2003
TW-1	L61564	320	8-inch	225-320	21	0-225 (not screened)	2003
TW-2	L34418	300	8-inch	80-230	22	0-205 (80-205)	2003
SW-1	Hood 335	63	6-inch	5-63	6.5	not cased	1981

Methods/ Analysis

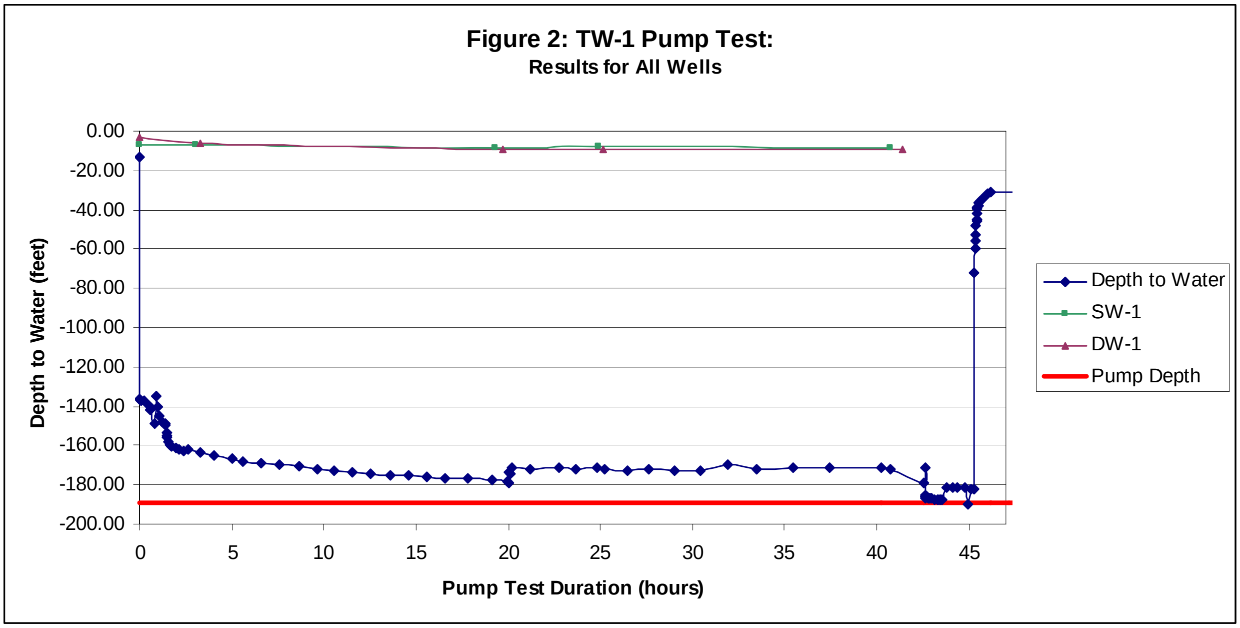
The wells were pumped to estimate their sustainable yield and determine water temperature. Both wells were tested with the same submersible 30 hp pump; TW-1 was tested between January 10 and January 12 and TW-2 between January 21 and January 22. Both wells were pumped at a continuously increasing step-drawdown rate until a stable drawdown was insured for a known maximum withdrawal. Temperature data was also collected periodically throughout the test with a calibrated digital thermometer.

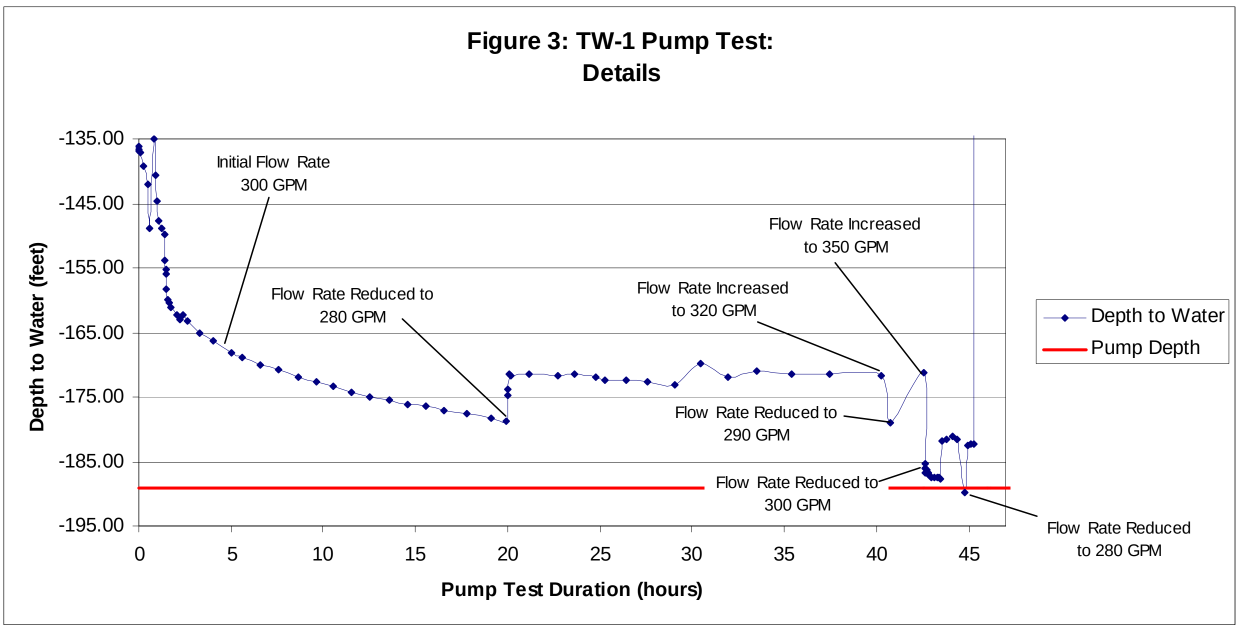
TW-1 Pump Test

Testing of TW-1 began at 2:30 pm on 10 January 2007. The test pump was set at 189 feet below ground surface, requiring all water flowing to the pump to come from below (i.e. through the bottom of the unperforated casing). The majority of material below the casing is andecite, and, given the sensitivity to flow rate variations, has good water bearing qualities. The well was initially pumped at 300 gpm, quickly producing a drawdown from a static water level of 15.3 feet to about 160 feet below the casing rim and continuing a slower decline to about 180 feet after 20 hours of pumping. The pumping rate was then reduced to about 280 gpm and the well showed an immediate recovery with depths to water rising to 174 feet. This flow rate and water level were maintained for 18 hours.

Higher flows up to 350 gpm were tested, all resulting in water level declines within two feet of the pump. Pumping was stopped after 46 hours and water levels immediately recovered 150 feet and were within 20 feet of the starting static water level in one hour.

Figures 2 and 3 illustrate the results from the TW-1 test. Figure 2 shows measured water levels throughout the entire test, including levels from the DW-1 and SW-1 observation wells. Figure 3 shows the measurements for TW-1 only, in the range of 135-195 below the casing rim, and adds detail regarding changes in flow rate to illustrate the well's sensitivity to flow rate changes.





TW-1 Temperatures

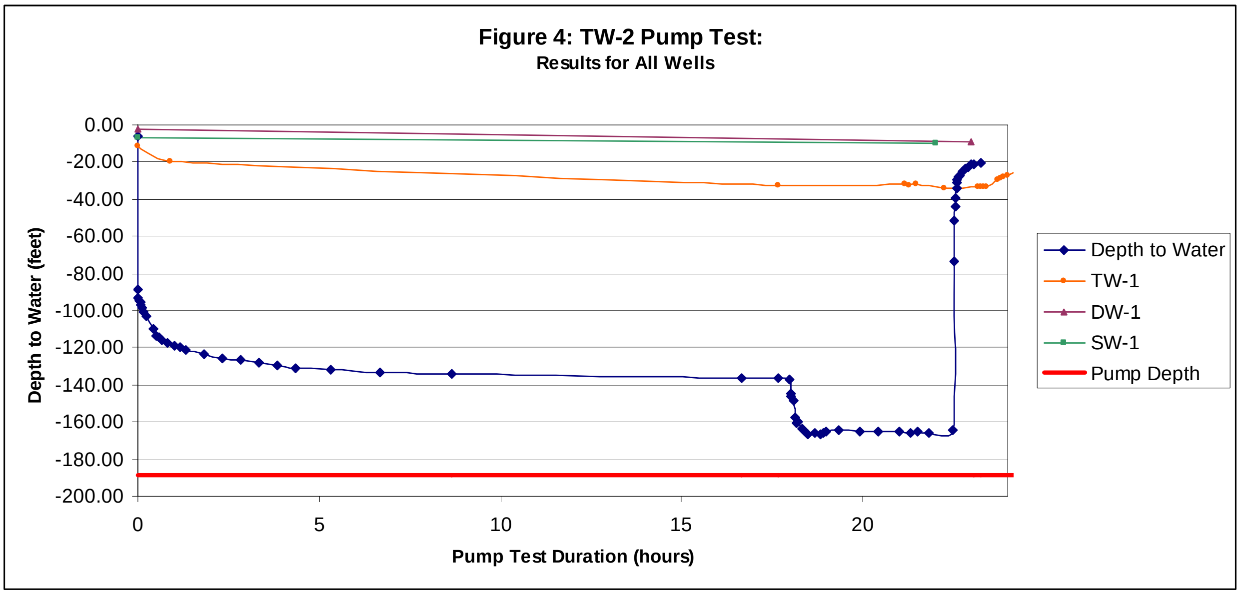
Two 7-day thermographs recorded water temperatures at the pipe outlet for TW-1 about 200 feet away from the wellhead. Temperatures remained constant at 47˚F throughout the entire test. Over the final three hours of the test, a calibrated digital thermometer recorded 6 measurements of 44.1°F at the same sampling location.

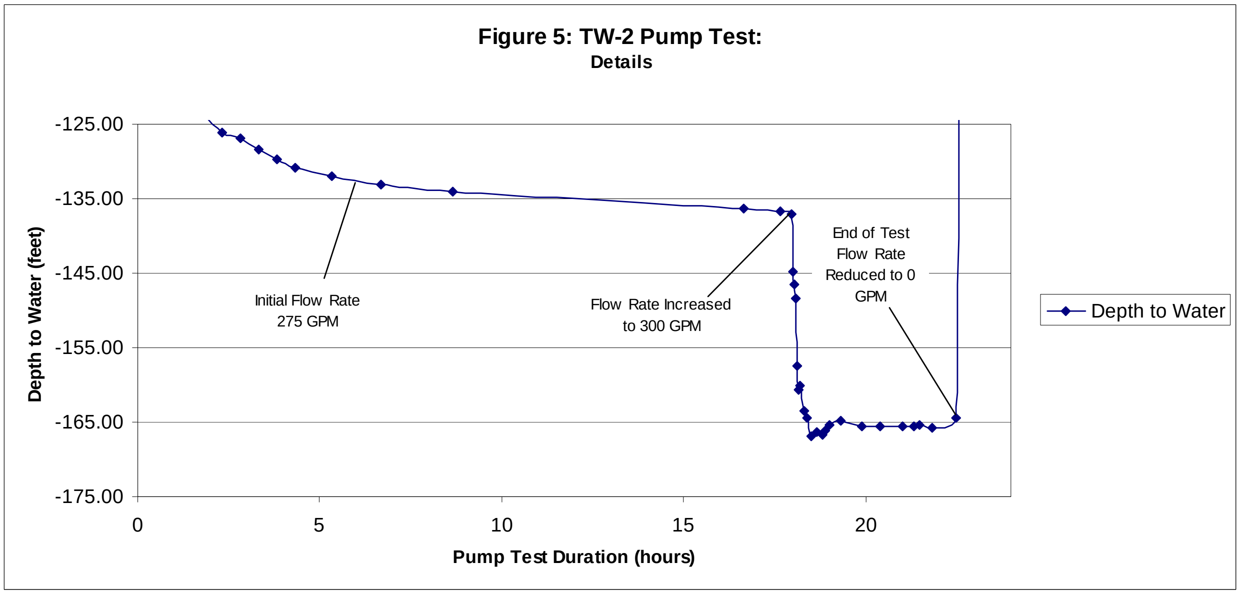
We concluded the thermograph equipment is not calibrated, and the true temperature of the TW-1 discharge was 44.1°F throughout the test. Heat loss calculations based on pipe material, flow retention time and ambient weather conditions indicated a maximum heat loss of 0.18°F between the wellhead and the discharge point. In short, pump test results for TW-1 indicated a consistent temperature no greater than 42.3°F. The pump test is not able to predict whether TW-1 will exhibit seasonal temperature variations.

TW-2 Pump Test

Testing of TW-2 began at 1:30 pm on 22 January 2007. The test pump was set at 189 feet, allowing water into the well through the perforations and from below the pump. Like TW-1, water levels in TW-2 reacted quickly at the start and conclusion of the test. An initial flow rate of 275 gpm rapidly dropped water levels from a static water level of eight feet to 130 feet, and slowly decreased to 139 feet. The pumping rate was increased to 300 gpm, dropping the water level to 167 feet. This pumping rate was maintained until water levels began to recover. Pumping rates higher than 300 gpm could not be attained even though water levels began to recover. The well was pumped at 300 gpm for five hours and the test terminated after 24 hours. Water levels recovered to within 30 feet of the static water level 30 minutes after pump shutdown.

Figures 4 and 5 illustrate the results from the TW-2 test. Figure 4 shows results from the entire test, and includes plots from the observation wells. Figure 5 shows detailed water levels between 125 and 175 feet below the casing rim, and shows the slight recovery at the 300-gpm flow rate.





TW-2 Temperatures

The same calibrated digital thermometer that was used in TW-1 recorded temperatures at the pipe outlet of TW-2. Temperatures ranged between 44.6 and 44.8˚F over a 30-minute period at the start of the test, but after two hours had dropped to 43.7˚F and held throughout the remainder of the test.

Observation Wells

DW-1/ SW-1

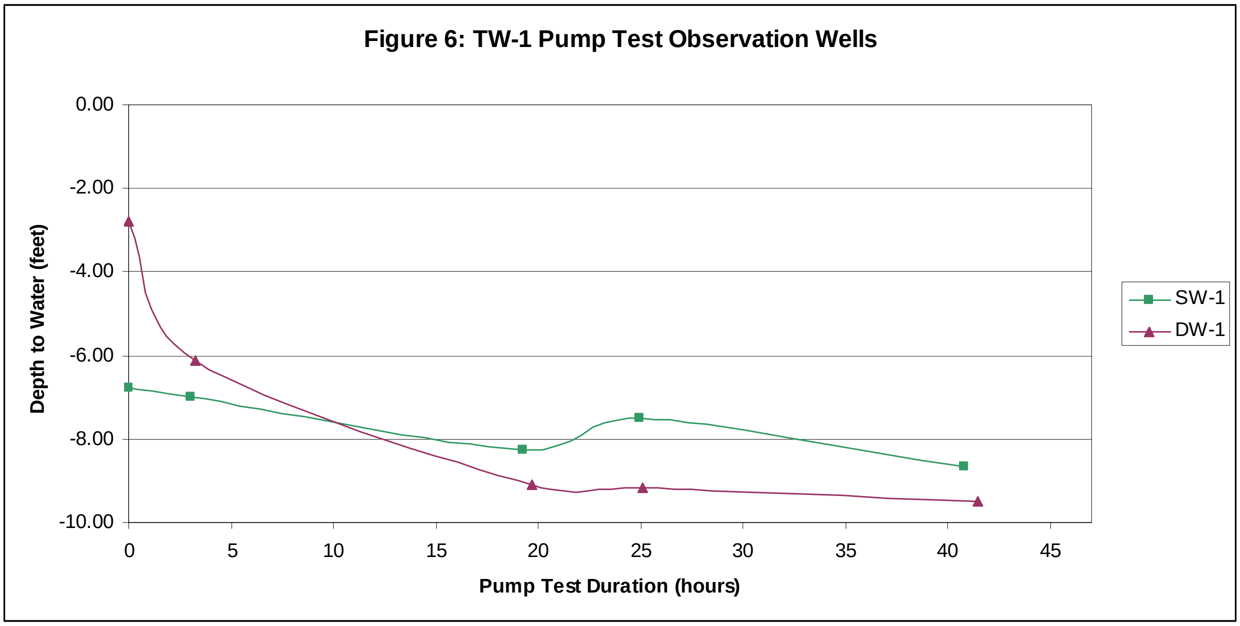
Water levels in DW-1 were monitored during the pump tests, and water level changes were very similar in both tests, dropping 6.5 feet from a static water level of about 2.5 feet. Water levels in SW-1 dropped approximately 3 feet from a static water level of 6.5 feet. There is a clear connection between pumping of the test wells and drawdown in the nearby domestic wells. This test could not determine the specific interference that could occur, but given the shallow depth of the pump in SW-1 (23 feet), development of either of the test wells could affect its yield. Continuous pumping of either test well may also affect yield in DW-1, but as this well in much deeper (100 feet), the risk of detrimental interference is less.

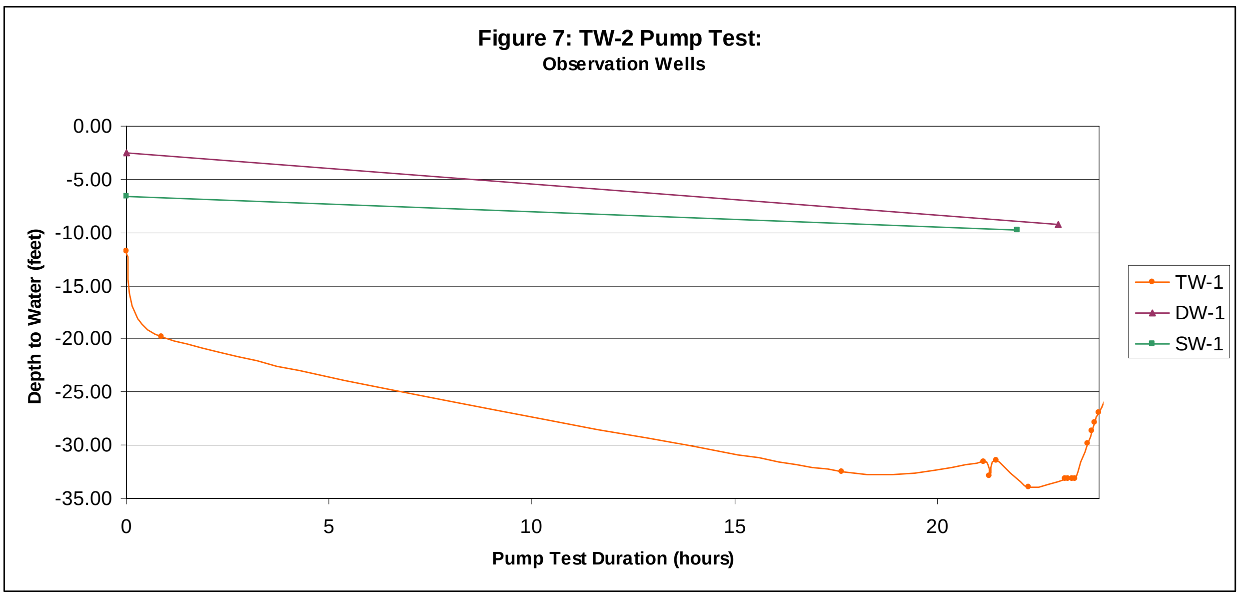
TW-1

Water levels in TW-1 were recorded during the TW-2 pump test to evaluate the connectivity of the two water bearing zones. At the start of testing TW-2, TW-1 had a static water level of about 12 feet below ground surface. Water levels during testing dropped to approximately 20 feet over the course of 20 hours while TW-2 was pumped at 275 gpm. When the pumping rate of TW-2 was increased to 300 gpm, TW-1 recovered slightly before dropping to about 34 feet. After 50 minutes of pumping TW-2 at 300 gpm, water levels in TW-1 began to recover.

No interference data was available between these two wells during the testing of TW-1, due to the fact that the well top of TW-2 was capped (welded) and later removed during subsequent testing. The interference data collected during the TW-2 test, however, suggests the sustainable yield for each well (as reported under separate well testing) would be noticeably affected during the simultaneous pumping of the two wells.

Figures 6 and 7 show water levels in the observation wells during the tests. Figure 6 shows the drawdown in DW-1 and SW-1 from the TW-1 test. The cause of the slight "bump" that occurs in the middle of the test is not known, but could be the delayed reaction to the flow rate decrease that occurred a few hours prior. Figure 7 shows drawdown in TW-1, DW-1 and SW-1 during the TW-2 test. TW-1 was monitored frequently during the TW-2 test, and water levels mimicked those in the pumping well.





Conclusions

The pump tests performed at the PFF are used to determine which of the two test wells are better suited for development. Based on the pump tests, well construction and similar temperatures between TW-1 and TW-2, it is our opinion that TW-2 will be the more productive well with flow rates around 300 gpm. Both wells have similar sustainable yield and temperature; however, TW-2 maintained a slightly higher flow rate, and may be able to produce higher flows with a larger pump or different pump level settings. The construction of TW-2 allows water to enter the well from both below and above the level of the pump, whereas TW-1 allows water to enter the well only from the bottom. TW-2 provides greater access to water across the vertical profile and this might be the reason for the higher yield of TW-2.

It is also important to note the reported yields for each well apply only to the separate pumping of each well. Simultaneous operation of each well would reduce the yield accordingly. The exact extent of that impact would require additional testing.

The temperature difference between the test wells was 0.4˚F, with temperatures of TW-1 at 44.1˚F and TW-2 at 43.7˚F, possibly due to the different depths at which water enters the wells. Large temperature variations between the two wells are unlikely.

The BPA has surface water rights for 5.59 cfs at the PFF. Before any groundwater sources can be developed, a groundwater right will need to be secured. There are no groundwater rights in this Section, however there are four exempt domestic wells nearby. Three of these are used for the residences at the PFF and one (SW-1) used for a private residence owned by Jack Sanders. The pump tests showed that development of either TW-1 or TW-2 could have an effect on these domestic wells, with SW-1 being particularly susceptible to interference due to its shallow pump depth. Lowering of the pump in SW-1 would help minimize interference.

APPENDIX H: PFF FLOOD PROTECTION ALTERNATIVES MEMO

HDR | ONE COMPANY *Many Solutions*℠

Memo

To:	Sarah Branum, Nancy Weintraub, BPA		
From:	Shane Cline, PE; Joelle Bennett, EIT	Project:	BPA Parkdale Fish Facility Feasibility and Conceptual Design for Flood Protection
Copy:	Ed Donahue, Keith Underwood, Mike McGowan, File		
Date:	October 18, 2007	Job No:	1988-053-15 (BPA); 37863 (HDR)
Re:	**Alternatives Analysis for Parkdale Fish Facility**		

Introduction

The Parkdale Fish Facility is located west of Parkdale, Oregon, along the Hood River County owned Red Hill Drive. The facility is east of the Middle Fork of the Hood River and experienced flooding and debris flows from the Middle Fork during a November 2006 event. As a result of these floods, the Middle Fork abandoned its historic channel and started flowing in a newly formed channel closer to the facility. The same flood also destroyed the US Forest Service bridge on Red Hill Drive crossing the Middle Fork of the Hood River. The immediate instability of the area following this historic flood is thought to have increased the potential for the Parkdale Fish Facility to be damaged in subsequent flooding. This memorandum presents the results of the investigation of several potential alternatives for protecting the site.

Channel Description

The Middle Fork of the Hood River flows northeasterly from Mount Hood toward the City of Hood River (Figure 1). It is a tributary of the Hood River and joins the East and West Forks north of Parkdale. The upstream reach of the Middle Fork, near the Parkdale Fish Facility, is tightly constrained on the east by a historic lava flow. Once the channel flows north past the outcrop, it widens suddenly and enters an area of relatively low energy, creating a depositional zone; therefore, debris that is moved through the upstream constrained zone is deposited in the area immediately downstream of the lava flow. This depositional area extends from the historic lava flow to an area near the BPA “Big Eddy” power transmission lines north of the Parkdale Fish Facility. Following a debris flow event similar to the November 2006 event, an enormous amount of material was deposited and significantly reduced the hydraulic conveyance capacity of the channel. This reduction caused the flood water to leave the channel and flow overland. During the November 2006 flood, the river created a new channel and started flowing in an easterly direction, bringing the main channel closer to the fish facility. The location of the Middle Fork is illustrated in Figure 1 and the historic and new channels are identified in Appendix A. Photographs of the channel are located in Appendix B.

Flood of November 2006

November 2006 was extremely rainy in Oregon. At Parkdale, 15.85 inches of rain were received over the month. The highest recorded daily precipitation during November 2006 was 2.38 inches. Additionally, six days during the month there were rainfalls greater than one inch. No streamflow gages exist in the Middle Fork of the Hood River, so no measurements were recorded; however, the result of the month of high rainfall was a large flood event that ultimately destroyed the Red Hill Drive Bridge. From photographs, it appears that boulders larger than six feet in diameter were mobilized during the high flow event. Photographs of the flood damage are located in Appendix B.

Potential for Subsequent Debris Flows

The debris flow that occurred during November 2006 was thought to be the result of remobilization of the terminal moraine located on the Elliot Branch glacier at the base of Mt. Hood and also mobilization of material stored in the Middle Fork channel of the Hood River. The event was initiated by rain falling on snow, resulting in very quick, or flashy, basin response. As the debris flow progressed downstream, additional material was mobilized through land slides and large scale bank failure, resulting in large numbers of logs also entering the debris flow.

As a result of the November 2006 debris flow, the Elliot branch and a stretch of the Middle Fork of the Hood River is largely absent of debris that could cause subsequent debris flows in the near future. As material starts to accumulate in these areas, the potential for debris flows will increase; however, it is anticipated this will take many years to accumulate to any significant risk (as much as several decades).

As discussed above, the November 2006 debris originated in the Elliot Branch below Mt. Hood. Aerial investigations of the Coe Branch did not observe material mobilization. Although the potential for future debris flows has been significantly reduced (a result of the Elliot Branch material removal) the presence of material in the Coe Branch indicates the potential remains for subsequent debris flows at the Parkdale Fish Facility.

Areas of Concern

Field observations have identified three locations along this reach of the Hood River Middle Fork that have the potential to threaten property or operating conditions at the Parkdale Fish Facility: channel migration at the toe of the lava flow, the undersized bridge on Red Hill Drive, and channel migration near the Parkdale Fish Facility. These areas are identified in Figure 2.

The most upstream location of concern is at the toe of the lava flow. At this location there is a risk that the river will overtop the bank and potentially create a new channel to the east, ultimately combining with Rogers Creek, which runs west-to-east north of the old lava flow. This would likely create an extremely unstable channel that could continue to migrate throughout the lower elevations up to the Parkdale Fish Facility.

The second area of concern is at Red Hill Drive. During the November 2006 flood, the bridge opening created a high velocity zone by constricting the channel, causing a buildup of large woody debris, resulting in the bridge's destruction. The high velocity from the constriction is also thought to have contributed to the formation of the new channel that is closer to the hatchery buildings. As described above, this bridge was destroyed as part of the November 2006 flood so the existing constriction has effectively been removed; however, if the bridge is replaced in the future and does not allow for a larger opening, it should be anticipated that the exaggerated cycle of deposition upstream of the bridge will continue.

The final area of concern is the new channel near the fish facility. A portion of the flow of the Middle Fork has been diverted from its preflood channel into a new area. (It is important to note that although this area is considered new, the channel has exposed gravels, cobbles, and boulders indicating it has experienced flows in the past.) The new channel created in November 2006 is closer to the Parkdale Fish Facility property than the previous channel. This new channel is deeper and narrower than the existing channel and, therefore, has more energy for degradation and migration. The new channel is very unstable and will continue to adjust its channel geometry and location within the floodplain.

Selected Hydrology

Because the Middle Fork of the Hood River is ungaged, hydrologic calculations were used to estimate streamflows at this location. The selected method is a basin-to-basin area adjustment between the Hood River's West Fork and the Middle Fork. The first step of the process is to obtain peak flows for the gaged basin. For this analysis, the new hydrologic statistics software from the US Army Corps of Engineers, HEC-SSP, was used to evaluate peak flows for the West Fork. The basin area adjustment is accomplished by multiplying the peak flows from the West Fork by the ratio of the Middle Fork basin area (a smaller number), divided by the West Fork basin area (a larger number). This effectively scales down the West Fork peak flows to a basin the size and location of the Middle Fork. The resulting flows are shown in Table 1.

Table 1: Estimated Peak Flows for Middle Fork Hood River at Red Hill Drive

Recurrence Interval (years)	Peak Flow (cfs)
500	7,356
200	6,453
100	5,767
50	5,112
25	4,489
10	3,647
2	689

Hydraulic Model

Using the selected hydrology presented above and the recent survey information, a simplified HEC-RAS (River Analysis System, version 3.1.3) hydraulic model was developed for this reach of the Middle Fork of the Hood River. The survey data included 18 cross-sections; 9 of which were included in the model. Due to the steep terrain and subsequent high stream velocities, the surveyor was not able to capture channel depths; therefore, it was assumed that the channel was two feet deep. Ineffective flow areas (areas where the water is considered to have no velocity, such as on the fringes of a floodway) were placed at the outer bounds of the channel so any flooding within the fish facility site would act as a normal floodway. Appendix C contains a profile of this reach of the Middle Fork.

The assumptions used to create the model include the parameters in Table 2.

Table 2: HEC-RAS Model Parameters

Parameter	Selected	Input Value
Upstream Boundary Condition	Normal depth	0.041 ft/ft
Downstream Boundary Condition	Normal depth	0.036 ft/ft
Manning's (Channel Roughness)	Mountain streams, gravels, cobbles, boulders	0.035 channel/ 0.10 overbanks
Flow Regime	Mixed (Subcritical and Supercritical)	Not applicable

The model results illustrate the flooding mechanism in the vicinity of the fish facility. Because the floodplain is so wide after the constriction at the bridge opening, the stream flow slows down and spreads out. This creates a situation in which increasing flood flows cause very little increase in water surface elevation, i.e., there is 0.5 foot difference in water surface elevation between the 50- and 500-year events, even though the flow rate is nearly 1.5 times larger. In addition, according to the model, smaller events such as flows in the 3- to 5-year recurrence interval range can overflow the banks and spread toward the hatchery.

Permits

Environmental permits will be minimized if all impacts can be outside the ordinary high water mark. Additionally, conversations with Hood River County indicate two county departments are interested in construction near the river. The Building Department will be interested in berm construction and other construction activities on private property to ensure correct construction procedures and materials are used. The Planning Department will be interested due to the projects proximity to the River. However, this area is not covered by the County's Floodplain Zone (Article 44) or the Stream Protection Overlay Zone (Article 42). Consequently, as long as impacts are not closer than 25 feet from the ordinary high water mark, the County Planning department involvement is anticipated to be minimal.

Failure Mechanisms and Risk

At the Parkdale fish facility site, there are three major types of events that could threaten people and property: flooding, debris flows, and channel migration. Each event could negatively impact the site and must be considered separately as they each present very different risks.

Flooding

Heavy rains in the basin can cause flooding the Middle Fork of the Hood River. Flooding potential near the Parkdale Fish Facility is relatively high because the facility is located in a relatively low area adjacent to the river. Each time the river overtops its banks, the potential for flooding of nearby infrastructure exists. To protect this facility from flooding, a barrier such as a soil berm could be used to separate the buildings from the river. The success of such a berm would depend on the quality of material (preferable a clayey soil), proper compaction, site soil type (extremely sandy soils could cause failures), and maintenance. Without accounting for these four factors, especially maintenance, a berm may fail. When a berm fails in one section, the area behind the berm floods and water is often trapped behind the berm unable to recede as the river recedes. Other options for flood protection include raising existing structures on stilts or moving the facility altogether.

Debris Flows

Debris flows occur when a sudden release of water occurs upstream of the site picking up trees, boulders, and other objects as the flood crest proceeds downstream. Debris flows are extremely dangerous because of the mass of debris entrained in them. The presence of this debris in the river increases the potential of structures within the flow path being significantly damaged. This is illustrated by the complete destruction of the former Red Hill Road bridge. This bridge was destroyed by the debris flow ripping out the main span of the bridge and depositing large boulders, trees, cobbles, and silt throughout the area. Debris flows are difficult to protect against due to their unpredictability, large volume of both water and debris, and relatively infrequent occurrence. The force behind these flows is very difficult to predict; the best measures are adequate channelling through tight spaces (such as bridges), and setting buildings far from the river. With the exception of removing the facilities, none of the alternatives presented below can significantly reduce the risks to the facility in the event of another debris flow.

Channel Migration

The third event that could threaten the Parkdale Fish Facility is channel migration. During the November 2006 event, the Middle Fork jumped from its existing channel to a new one created by the force of the flood and debris. The new channel is significantly closer to the facility and there is the possibility that it will continue to cut toward the facility during subsequent high flow events. There are few means of mitigating this risk without significant in-channel work. One recommended method is to “key in” a concrete trench below and through a berm, creating a solid barrier to help control channel migration. The trench would be as deep as or slightly deeper than the expected channel to discourage undermining of the structure. This option could prove difficult to implement, as multiple permits would be required.

A second option to the reinforced trench would be to establish a healthy root zone in areas that are susceptible to migration. Willows, dogwoods and other native species are commonly used in riparian zones to provide some level of bank stabilization.

Alternatives for Flood Protection

Several alternatives were considered as part of this investigation:

- Alternative No. 1: Construction of a linear berm,
- Alternative No. 2: Construction of a linear berm with reinforced trench,
- Alternative No. 3: Raise roadway and increase bridge opening width,
- Alternative No. 4: Raise buildings,
- Alternative No. 5: No flood protection - move facility, and
- Alternative No. 6: No action.

These alternatives are further described below and in the alternatives matrix, Table 3. The major risks associated with each alternative are presented in Table 3, the alternatives matrix.

Alternative No. 1: Construction of a Linear Berm

The linear berm is a long mound of earth intended to act as a barrier between flood flows and adjacent low areas. This type of structure only provides protection against slow-moving water such as would be expected on the fringes of a floodplain. A linear berm cannot easily protect against channel migration but is relatively inexpensive and easy to construct. For this application, hydraulic modeling suggests that 1100 linear feet of a 2-foot-high berm may be required upstream of Red Hill Drive. An additional 150 feet of a 5-foot-high berm may be required across and downstream of the road. This is approximately 1300 cubic yards of material. Some of the boulders that were deposited during the November 2006 flood could be used to armor the face of the berm; this would help protect the berm from debris and high velocities. This alternative may also consider incorporating use of some of the large wood in the area to recruit material and help snag floating debris. This alternative would help protect the upstream landowner's residence as well as the Parkdale Fish Facility from floods. This alternative would only provide limited protection against channel migration or debris flows.

Alternative No. 2: Construction of a Linear Berm with Reinforced Trench

Similar to Alternative No. 1, the linear berm would be combined with a reinforced trench. In addition to confining floods, the reinforced trench would be as deep as required to provide some protection against channel migration. Given the heavily vegetated nature of much of the surrounding area, the trenching option may significantly impact the root zone of some of the nearby trees. Given the presence of vegetation and the anticipated cobble subsurface, these structures are anticipated to be more difficult to install and also more expensive than the simpler linear berm. This alternative would help protect the upstream landowner's residence as well as the Parkdale fish Facility from floods, debris flow, and channel migration. This alternative would only provide limited protection against debris flows.

Alternative No. 3: Raise Roadway and Increase Bridge Opening Width

Raising the road and widening the bridge opening would remove the constriction that is currently slowing stream velocities and creating a depositional zone. This design would also utilize the road as a berm to protect the hatchery facility from overland flow from the south. The old bridge on Red Hill Drive was 60 feet long with an estimated 10 feet of clearance between the channel bottom and bridge low chord. Increasing the roadway height would act as a berm to protect the fish facility, and the wider bridge opening would allow more water through than is currently possible. The increased velocities should mobilize some of the deposited debris and sediment and help the stream return to its historic channel. Depending on the specific site conditions, an additional small structure such as a simple berm may be needed downstream of the road to protect the hatchery manager's residence from flood water inundation. This alternative is the most complex and expensive; however, as it is a proposed replacement of damaged infrastructure, cost sharing with Hood River County and US Forest Service may be feasible. Special consideration is required during the design of the replacement bridge so as to not negatively impact the upstream property owner. At a minimum, it is recommended that a larger bridge opening with larger flood relief cross culverts be incorporated into the design.

Alternative No. 4: Raise Buildings

By elevating the fish facility manager's residence and other buildings on stilts, it would be possible to protect existing structures against flooding. However, stilts would not protect against debris flows or channel migration and may provide a false sense of security that would delay evacuation in an event similar to that experienced in November 2006. This alternative is only a viable alternative to structures that are not at- or below grade. This alternative would provide no flood relief to the upstream landowner and would only provide limited protection against channel migration or debris flows.

Alternative No. 5: Move Facility

By abandoning the Parkdale site and moving the facility to a different location, the risk of flooding, debris flows, and channel migration are no longer a threat to employees or operations at the facility. This alternative does not provide any protection to the upstream landowner.

Alternative No. 6: No Action
The final alternative is a no action alternative for 2007. Although this is the simplest alternative, it provides no protection against flooding, debris flows, or channel migration to either the fish facility or the upstream landowner.

Alternatives Matrix

Table 3 evaluates each alternative for relative cost, permitability (ease of obtaining permit), and response time for each of the proposed alternatives as well as summarizing the pros and cons of each. There are no rankings for cost, permitability, and time for Alternative No. 6 as it requires no work to be completed.

It should be noted that very few alternatives protect against channel migration and none, with the exception of Alternative 5, can protect against debris flows. For Alternatives 1 through 4, proper maintenance would be critical to provide protection to the Parkdale Fish Facility.

Table 3: Flood Protection Alternatives Decision Matrix

Alternative	Description	Pros	Cons	Relative Cost*	Permit-ability**	Response Time***
Alt. No. 1 Linear Berm	Long, narrow mound of earth to block flood flows. **Does not protect against channel migration or debris flows.**	• Easily constructed. • Stays outside of regulated areas (i.e. permitable). • Protection up to 500-year event. • Inexpensive. • Provides protection to upstream landowner.	• Berm required on roadway (could lead to a future vertical road alignment change; impact to nearby wetlands unknown). • Does not protect against channel migration or debris flows. • Maintenance critical to continued protection.	$	💧	🕒
Alt. No. 2 Linear Berm with Reinforced Trench	Long, narrow mound of earth with reinforced trench throughout. **Does not protect against debris flows.**	• Provides flood protection. • Provides protection against channel migration. • Provides protection to upstream landowner.	• Increased cost over berms. • More difficult construction. • Likely difficult to permit. • Maintenance critical to continued protection.	$$	💧💧💧	🕒
Alt. No. 3 Raise Road and Increase Bridge Opening	Design and rebuild washed out road and bridge to ease hydraulic issues. **Does not protect against channel migration or debris flows.**	• Some protection to Parkdale Fish Facility. • Could force Middle Fork back into main channel. • Cost-sharing. • Rebuilding damaged infrastructure.	• Higher road means steeper access to nearby hatchery building. • Relatively expensive. • Coordination with USFS and Hood River County. • Could adversely impact upstream landowner. • May create a fish trapping scenario.	$$$	💧💧	🕒🕒🕒
Alt. No. 4 Raise Buildings	Elevate buildings to protect from flood waters. **Does not protect against channel migration or debris flows.**	• Provides flood protection.	• Does not protect against debris flows or channel migration. • Does not protect other facility structures that cannot be raised.	$$	💧	🕒🕒🕒
Alt. No. 5 Move Facility	Halt operations at Parkdale and relocate facility to another site with less risk.	• Eliminates the risks inherent at this site.	• Relatively expensive. • Loss of fisheries infrastructure.	$$$	💧	🕒🕒
Alt. No. 6 No Action	Do nothing to protect Parkdale Fish Facility from winter flood events. **Does not protect against flooding, channel migration, or debris flows.**	• No funding or permits needed.	• Leaves Parkdale Fish Facility at risk for damage from flooding or channel migration.	N/A	N/A	N/A

* Relative Cost – ranked low cost ($) to high cost ($$$)
** Permitability – ranked easily permitable (💧) to difficult to permit. (💧💧💧)
*** Response Time – ranked short response time (🕒) to long response time (🕒🕒🕒)

Preferred Alternative

After discussion with representatives of the Parkdale Fish Facility, the BPA, and USFS, it appears the preferred alternative is to construct an interim linear berm. A berm can provide protection against flood waters in the coming winter. Afterward, a more permanent solution to alleviate flood and channel migration concerns can be selected and implemented. As additional flood protection, the interim berm could be left in place once the permanent alternative is complete.

The benefits of this alternative include:

- Quickly implemented flood protection,
- Permits may not be required,
- Relatively inexpensive compared to other interim options, and
- Provides protection to the upstream landowner's residence.

Action Plan

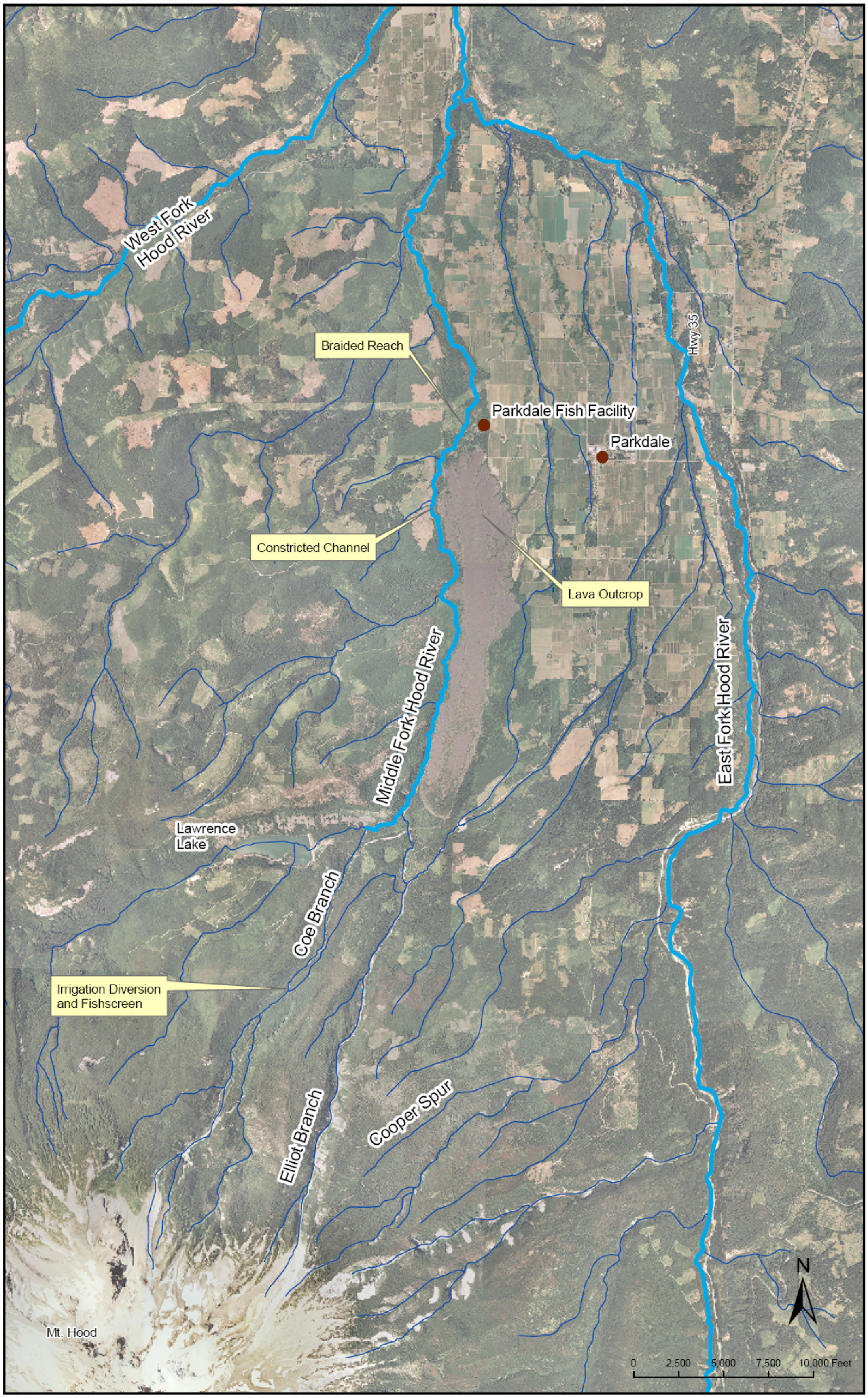
In addition to implementing one of the identified alternatives, the development of an Emergency Action Plan is highly recommended. The purpose of this action plan would be to anticipate foreseeable events and provide direction to people in an attempt to minimize impacts to people, fish, and property. It is anticipated the contents of an action plan would identify emergency notification procedures, emergency evacuation procedures, and recommended responses.

Contingency Plan

In the event that no alternatives are constructed by winter 2007/2008, the development of a contingency plan is also recommended. The purpose of this Contingency Plan would be to allow the Parkdale Fish Facility to quickly implement protective measures to minimize risk and financial impacts to the facility. As discussed above, the preferred alternative is to construct a berm as discussed in Alternative No. 1. At a minimum, key elements to the contingency plan would include:

- Identification of local contractors with the ability to mobilize quickly and have the appropriate heavy equipment to construct the berm. Ideally, a time and materials contract would be in place that would give fish facility staff the ability to respond to a flooding event with minimal delays.
- Identifying appropriate contracting mechanisms to obtain a contractor in short notice. It may be easier to have a private party enter into this contract.
- Identifying local sources of clayey soil appropriate for construction of the linear berm.
- Working with civil and geotechnical engineers to develop a typical berm design.
- Identifying the approximate location of the berm in the field with approximate elevations of berm and required height.
- Having sand bags delivered to the Parkdale Fish Facility that can be used by hatchery staff.

Figures

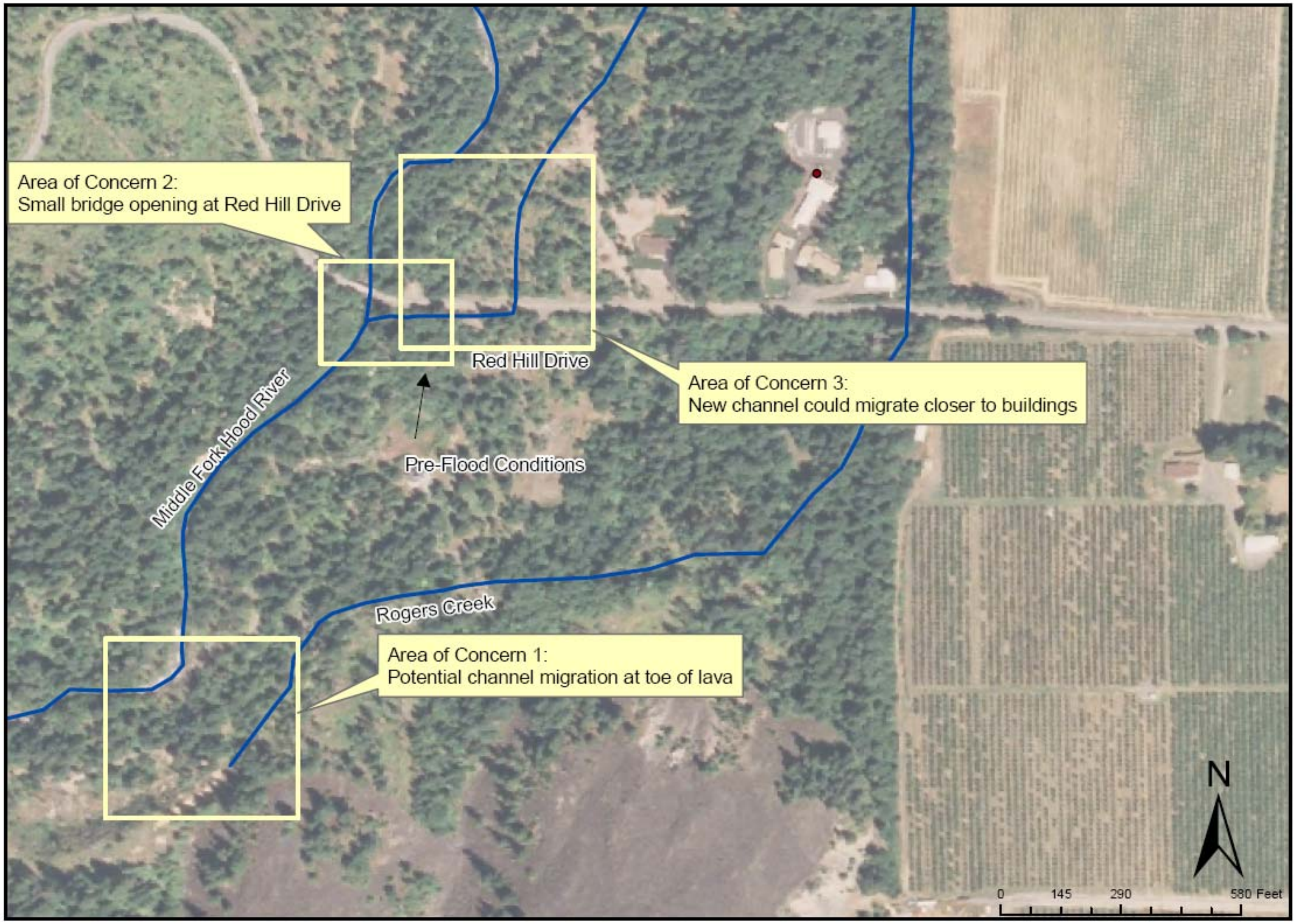


HDR ONE COMPANY | Many Solutions

Middle Fork Hood River Basin

FIGURE 1

Bonneville Power Administration | Parkdale FF Feasibility and Conceptual Design for Flood Prevention



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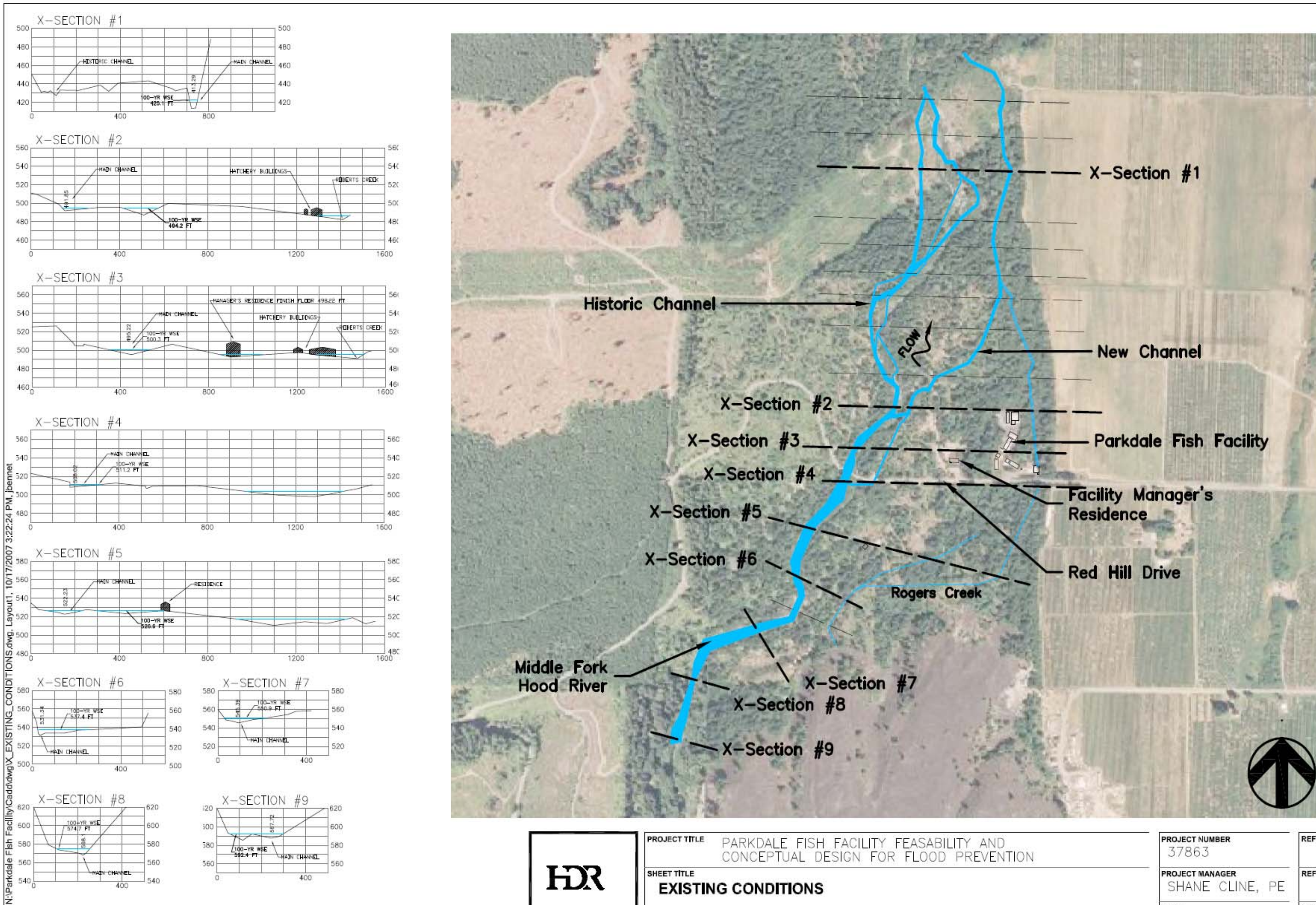
Parkdale Fish Facility - Pre-Flood Conditions

FIGURE 2

Bonneville Power Administration | Parkdale FF Feasibility and Conceptual Design for Flood Prevention

Appendix A:

Existing Condition and Surveyed Cross-sections



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	SHEET TITLE: EXISTING CONDITIONS	PROJECT MANAGER: SHANE CLINE, PE	REFERENCE DOCUMENT: –
		DATE: 10/17/2007	EXHIBIT NUMBER: –

Appendix B:

Photographs

Debris at Red Hill Drive after November 2006 flooding.

Part of the log jam that saved Parkdale Fish Facility.

New channel formed downstream of Red Hill Drive.

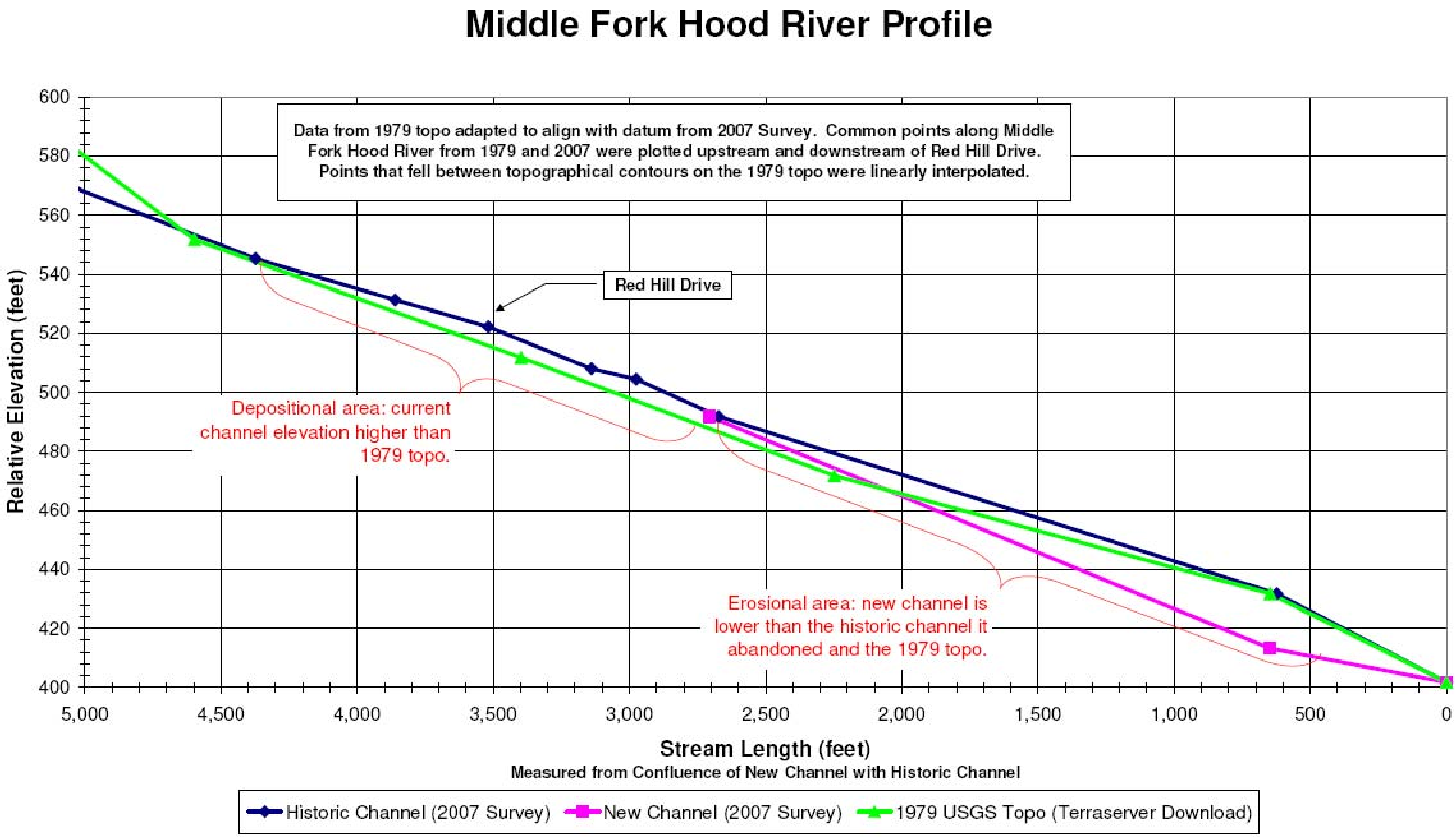
Post-flood clean up activities on Red Hill Drive (road centerlines beneath excavator in foreground).

Typical channel upstream of Red Hill Drive.

Privately owned Sander's residence in foreground; Middle Fork in upper left.

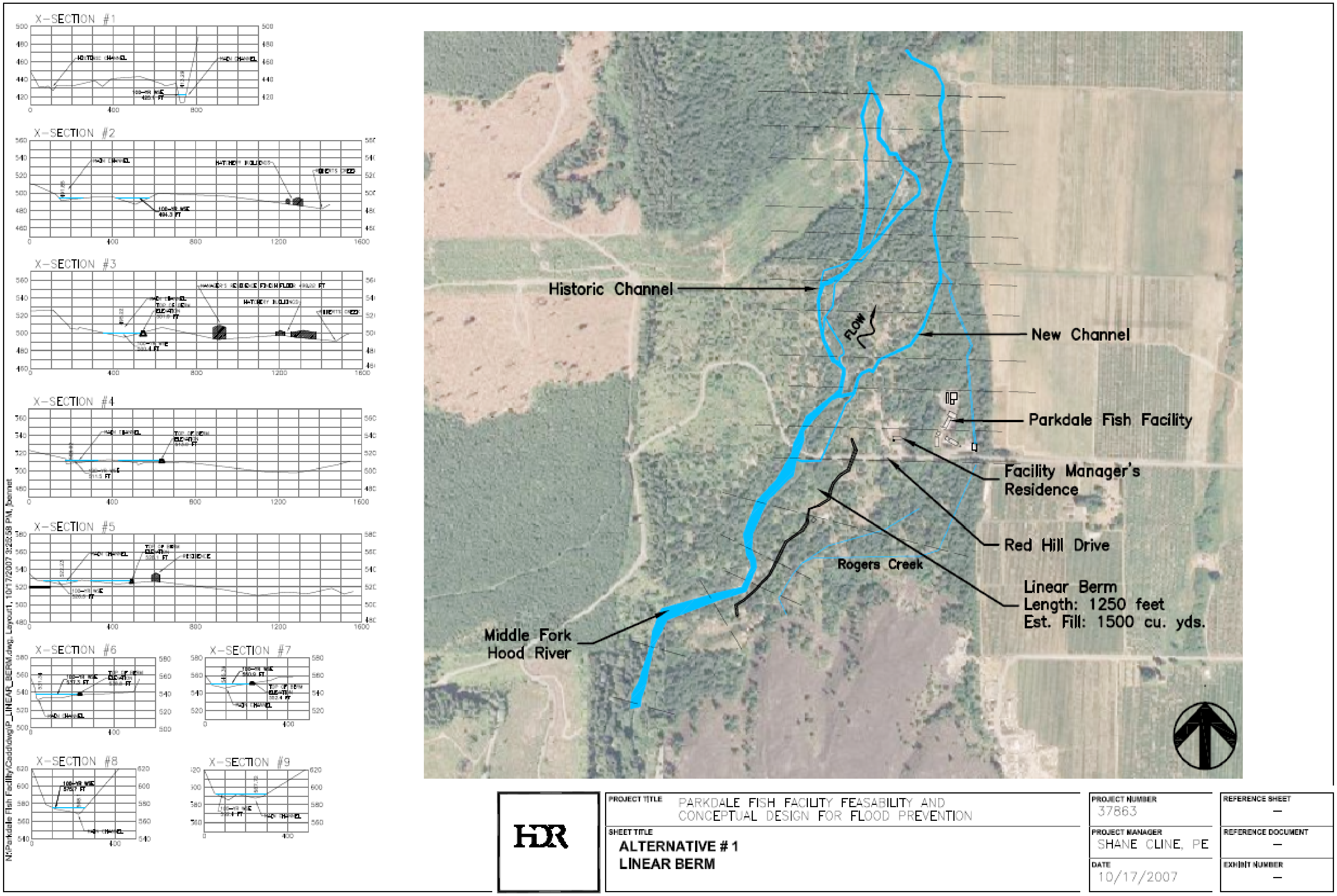
Appendix C:

Stream Profile


Middle Fork Hood River Profile
Data from 1979 topo adapted to align with datum from 2007 Survey. Common points along Middle Fork Hood River from 1979 and 2007 were plotted upstream and downstream of Red Hill Drive. Points that fell between topographical contours on the 1979 topo were linearly interpolated.
Red Hill Drive
Depositional area: current channel elevation higher than 1979 topo.
Erosional area: new channel is lower than the historic channel it abandoned and the 1979 topo.
Relative Elevation (feet)
600
580
560
540
520
500
480
460
440
420
400
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Stream Length (feet)
Measured from Confluence of New Channel with Historic Channel
Historic Channel (2007 Survey)
New Channel (2007 Survey)
1979 USGS Topo (Terraserver Download)

Appendix D:

Alternative Layouts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X-SECTION #2
X-SECTION #3
X-SECTION #4
X-SECTION #5
X-SECTION #6
X-SECTION #7
X-SECTION #8
X-SECTION #9
Historic Channel
New Channel
FLOW
Parkdale Fish Facility
Facility Manager's Residence
Red Hill Drive
Rogers Creek
Linear Berm
Length: 1250 feet
Est. Fill: 1500 cu. yds.
Middle Fork Hood River
HDR
PROJECT TITLE
PARKDALE FISH FACILITY FEASABILITY AND CONCEPTUAL DESIGN FOR FLOOD PREVENTION
SHEET TITLE
ALTERNATIVE # 1
LINEAR BERM
PROJECT NUMBER
37863
PROJECT MANAGER
SHANE CLINE, PE
DATE
10/17/2007
REFERENCE SHEET
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REFERENCE DOCUMENT
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EXHIBIT NUMBER
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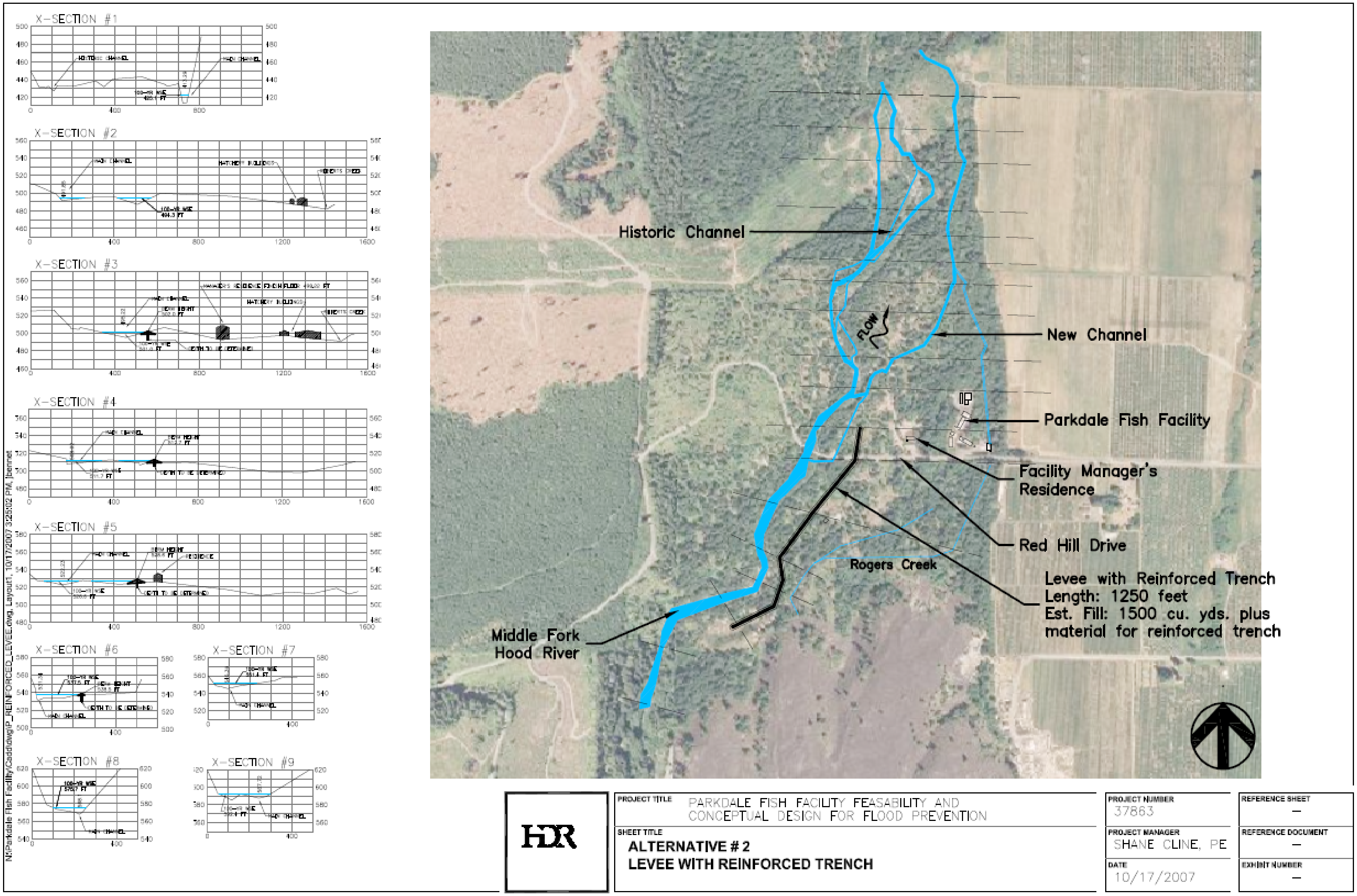
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X-SECTION #7
X-SECTION #8
X-SECTION #9
Historic Channel
FLOW
New Channel
Parkdale Fish Facility
Facility Manager's Residence
Red Hill Drive
Rogers Creek
Levee with Reinforced Trench
Length: 1250 feet
Est. Fill: 1500 cu. yds. plus material for reinforced trench
Middle Fork Hood River
PROJECT TITLE
PARKDALE FISH FACILITY FEASABILITY AND CONCEPTUAL DESIGN FOR FLOOD PREVENTION
SHEET TITLE
ALTERNATIVE # 2
LEVEE WITH REINFORCED TRENCH
PROJECT NUMBER
37863
PROJECT MANAGER
SHANE CLINE, PE
DATE
10/17/2007
REFERENCE SHEET
–
REFERENCE DOCUMENT
–
EXHIBIT NUMBER
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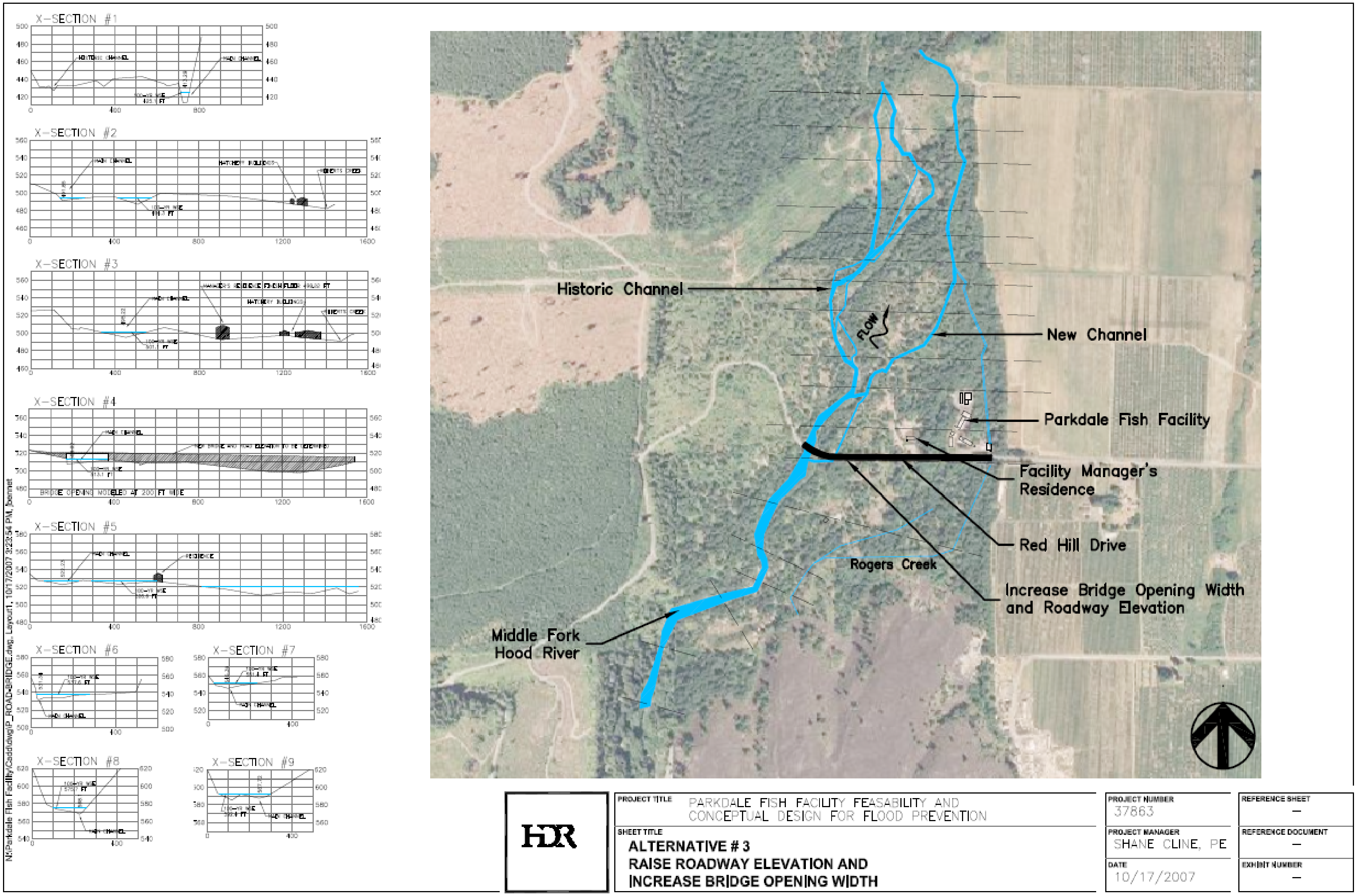
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X-SECTION #6
X-SECTION #7
X-SECTION #8
X-SECTION #9
Historic Channel
FLOW
New Channel
Parkdale Fish Facility
Facility Manager's Residence
Red Hill Drive
Rogers Creek
Increase Bridge Opening Width and Roadway Elevation
Middle Fork Hood River
HDR
PROJECT TITLE
PARKDALE FISH FACILITY FEASABILITY AND CONCEPTUAL DESIGN FOR FLOOD PREVENTION
SHEET TITLE
ALTERNATIVE # 3
RAISE ROADWAY ELEVATION AND INCREASE BRIDGE OPENING WIDTH
PROJECT NUMBER
37863
PROJECT MANAGER
SHANE CLINE, PE
DATE
10/17/2007
REFERENCE SHEET
–
REFERENCE DOCUMENT
–
EXHIBIT NUMBER
–

APPENDIX I: SPRING CHINOOK HGMP

HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Hood River Production Program
Species or Hatchery Stock:	Spring Chinook Salmon
Agency/Operator:	Confederated Tribes of the Warm Springs / Oregon Department of Fish and Wildlife
Watershed and Region:	Hood River, Oregon
Date Submitted:	June 23, 2000
Date Last Updated:	April 18, 2008

SECTION 1. GENERAL PROGRAM DESCRIPTION

This document describes the current program and revised program after completion of the HRPP Master Plan revisions. The "current program" will continue through final smolt release in 2009. The "revised program" will begin with collection of brood in 2008 with a 2010 smolt release. The current program is fully described in the Hood River Production Program Master Agreement (ODFW and CTWS, unpublished) and the Revised Hood River Production Program Master Plan (Underwood et al. 2008. *in press*).

1.1) Name of hatchery or program.

Hood River Production Program (HRPP).

1.2) Species and population (or stock) under propagation, and ESA status.

Oncorhynchus tschawytscha, spring Chinook salmon. Non-listed extirpated stock.

1.3) Responsible organization and individuals

Name (and title): Chris Brun, Program Coordinator
Agency or Tribe: Confederated Tribes of the Warm Springs Reservation of Oregon
Address: 6030 Dee Hwy. Parkdale, Oregon, 97041
Telephone: (541) 352-3548
Fax: (541) 352-9365
Email: cbrun@hrecn.net

Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

The current hatchery program is co-managed with the Oregon Department of Fish and Wildlife. Portland General Electric (PGE) provides rearing space in the Pelton Ladder.

Program revisions were developed with the assistance of HDR Fish Pro under contract with the Bonneville Power Administration (BPA). In addition to cooperators involved with the current program the U.S. Fish and Wildlife Serviec (USFWS) will be contracted to rear a portion of the hatchery production at Carson National Fish Hatchery, provide fish health support and technical assistance during comparative rearing evaluation studies.

1.4) Funding source, staffing level, and annual hatchery program operational costs.

Funding for both the current and revised programs is provided by the Bonneville Power Administration. The current annual budget for the spring Chinook salmon program is approximately $1.2 million allocated among four contracts with the BPA. Current contracts are:

BPA Project 1988-053-08 (Hood River Powerdale Dam Fish Trap / Pelton Ladder): Fiscal Year 2008 Budget: $428,395. 2 FTEs. This project is operated by ODFW to operate and maintain the Powerdale Dam Fish Trap and rearing of spring Chinook salmon at Round Butte Hatchery and Pelton Ladder associated with the HRPP. The project provides funding for PGE for use of a portion of the Round Butte Fish Hatchery to assist with rearing of spring Chinook for HRPP use.

BPA Project 1988-053-07 (Hood River Production Program O&M): Fiscal Year 2008 Budget: $396,534. 3 FTEs. This project is implemented by the CTWS to operate and maintain the Parkdale Fish Facility, which includes adult broodstock holding, spawning, egg incubation and a portion of the acclimation activities.

BPA Project 1988-053-03 (Hood River Production Program M&E): Fiscal Year 2008 Budget: $371,219. 4 FTEs. This contract is implemented by the CTWS to evaluate and monitor the re-introduction of spring Chinook including tribal harvest management.

Operations and maintenance costs for the revised program are expected to remain similar to the current program costs after adjustments for inflation. The cost of new infrastructure to implement the revised program is estimated to cost $1.1 million through 2013.

1.5) Location(s) of hatchery and associated facilities.

Adult Collection:

Current program: Broodstock are collected at the Powerdale Dam Fish Trap, located at the base of the Powerdale Dam (Hood River, River Mile [RM] 4.0). The goal is to use exclusively Hood River hatchery origin returns (HORs) except during years of low escapement. When production needs cannot be completely filled by Hood River origin returns eggs from broodstock taken at the Pelton Trap (RM 100) on the Deschutes River are used to backfill production needs.

Revised program: Broodstock will be collected at a fish trap located at Moving Falls, West Fork Hood River (RM 2.5). Broodstock will consist of 90% Hood River HORs and 10% natural origin returns (NORs).

Spawning, egg incubation, rearing:

Current program: Broodstock are collected at Powerdale Dam, taken to Parkdale Fish Facility where they are held, spawned, and incubated to the green or eyed egg stage. The eggs are transported to Round Butte Hatchery on the Deschutes River for final incubation and rearing. All final rearing currently takes place in the Pelton Ladder cells on the Deschutes River. Prior to 2007 final rearing for up to 30% of production occurred in Round Butte Hatchery raceways.

Revised program: Broodstock will be collected at Moving Falls weir, transported to Parkdale Fish Facility where they are to be held, spawned and incubated to eyed eggs using current operational procedures. Beginning in the fall, 2008, eyed eggs will be distributed to the following hatchery facilities for hatching and rearing:

Facility	# Reared	Life Stage Delivered To Acclimation Site
Round Butte Hatchery / Pelton Ladder	75,000	Pre-smolt
Carson National Fish Hatchery	45,000	Pre-smolt
Parkdale Fish Facility	30,000	Pre-smolt

Acclimation and release:
Current Program: 125,000 smolts are delivered to two acclimation sites in the West Fork and one site in the Middle Fork Hood River during April. West Fork acclimation sites include Blackberry Creek , located at RM 8.5 and Jones Creek at RM 14.5. Facilities at both sites consist of portable ponds with a flow through water source. Approximately 55,000 spring Chinook salmon are trucked from Pelton Ladder to Blackberry Creek acclimation site and 40,000 spring Chinook to Jones Creek acclimation site (95,000 total into the West Fork) where they remain for two weeks. After the holding period they are volitionally released into the West Fork Hood River. Non-migrants are trucked and released at the mouth of Hood River.

In the Middle Fork one acclimation pond at the Parkdale Fish Facility is used to volitionally release 30,000 spring Chinook salmon over a one month period. Non-migrants are trucked and released at the mouth of the Hood River.

Revised program: 150,000 smolts will be released in the West Fork Hood River (RM 2.5). Pre-smolts will be delivered to an acclimation facility at Moving Falls in late-February and forced released during late April.

1.6) Type of program.
Current and revised programs: Integrated- Reintroduction / Harvest.

1.7) Purpose (Goal) of program.
The goals of Hood River Production Program are to: re-establish and maintain a naturally self-sustaining spring Chinook salmon population in Hood River subbasin using Deschutes stock; and provide sustainable and consistent in-basin tribal / sport harvest opportunities.

1.8) Justification for the program.
The HRPP is a BPA funded program initiated as a mitigation measure for Columbia River hydrosystem effects on anadromous fish. It is jointly implemented by the Confederated Tribes of Warm Springs Reservation (CTWSR) and the Oregon Department of Fish and Wildlife (ODFW). The program consists of supplementation, research, monitoring, evaluation, and habitat improvements.

The indigenous Hood River spring Chinook salmon population was extirpated by the late 1960s. The current program objective is to re-establish a self-sustaining spring Chinook salmon population by using Deschutes River spring Chinook salmon as the donor stock.

The hatchery program is a conservative approach that has started with a lower hatchery smolt allocation (125,000 smolts), instead of 250,000 smolts identified in the original Hood River Master Plan. With the lower hatchery production, perceived risks to listed steelhead should be minimized while HRPP monitors any potential impacts.

The scheduled decommissioning of Powerdale Dam during 2010 will eliminate our broodstock collection facility. As a result, the HRPP is undergoing the NWPCC's Step Review process to re-direct the spring Chinook salmon program given the new circumstances. Two seasonally-operated weirs are proposed to collect program broodstock. Spring Chinook will be collected in the West Fork Hood River at Moving Falls (Rm. 2.5) and winter steelhead in the East Fork Hood River at RM 1.25. The Moving Falls weir is located downstream of approximately 80% of current spring Chinook salmon spawning. Given the location of the proposed weir managers will have the ability to regulate hatchery escapement to the majority of the spawning habitat and intensively monitor the results of the current re-introduction effort.

The ultimate goal of the spring Chinook salmon production program is to maintain all production within the Hood River basin. However several uncertainties require evaluation in order to determine if this is a feasible as well as cost effective goal. The approach of the revised program will be to initially release 150,000 yearling smolts from the Moving Falls rearing / acclimation site. The smolts will be reared at two out of basin facilities and one in basin facility as part of a hatchery evaluation study beginning in with eggs collected from the 2008 brood. After one complete brood year return in 2013 the results will be evaluated to determine the long term rearing approach.

1.9) List of program "Performance Standards".

The primary goals of the HRPP's spring Chinook salmon program are 1) to reintroduce spring Chinook salmon into the Hood River subbasin, and 2) provide in-basin sustainable harvest opportunities.

<u>Harvest</u>

Performance Standard (1): Hood River spring Chinook salmon production contributes to fulfilling tribal trust legal mandates and treaty rights.
Indicator 1(a): Estimated number of program Chinook harvested in tribal fisheries by run year.

Performance Standard (2): Fish are produced in a manner enabling effective harvest while avoiding over-harvest of listed fish.
Indicator 2 (a): Estimated run year harvest and harvest related mortality for hatchery and wild fish by fishery.

Performance Standard (3): Release groups are marked to enable determination of impacts and benefits in fisheries.
Indicator 3(a): Number of recovered marked fish reported in each fishery produces accurate estimates of harvest.

Indicator 3(b): Verify that mark rate, at release, is 95% to 100% for all smolt release groups.

Performance Standard (4): Non-monetary societal benefits for which the program is designed are achieved.
Indicator 4 (a): Number of tribal / sport fisher days.

Hatchery Performance
Performance Standard (5): The hatchery program produces smolts that are adapted to the basin and are similar to naturally produced smolts.
Indicator 5 (a): Survival of Chinook by life-stage in both hatchery and wild settings.

Performance Standard (6): The hatchery program uses standard scientific procedures to evaluate various aspects of artificial propagation.
Indicator 6 (a): Scientifically based experimental design with measurable objectives and hypothesis.

Performance Standard (7): Facility operations comply with applicable fish health and facility operation standards and protocols.
Indicator 7 (a): Results of monthly fish health examinations.
Indicator 7 (b): Annual reports indicating level of compliance with applicable standards and criteria.

Performance Standard (8): Releases do not introduce new pathogens into local populations and do not increase the levels of existing pathogens.
Indicator 8 (a): Results of monthly fish health examinations.
Indicator 8 (b): Certification of juvenile fish health immediately prior to release.
Indicator 8 (c): Juvenile rearing density.

Performance Standard (9): Any distribution of carcass products for nutrient enhancement meets appropriate disease control regulations.
Indicator 9 (a): Number and location of carcasses distributed for nutrient enrichment.
Indicator 9 (b): Disease examination of all carcasses to be used for nutrient enrichment.
Indicator 9 (c): Statement of compliance with applicable regulations and guidelines.

Performance Standard (10): Effluent from hatchery facilities will not detrimentally affect water quality of adjacent streams.
Indicator 10 (a): Verify that hatchery effluent is in compliance with existing water quality standards.

Performance Standard (11): Juvenile production costs are comparable to or less than other regional programs of similar scale and objectives.
Indicator 11 (a): Total cost of program operation.
Indicator 11 (b): Average cost of similar operations.

Performance Standard (12): Hatchery program is self-sustainable.

Indicator 12 (a): Number of broodstock collected is sufficient to maintain the hatchery brood and smolt production goals.

Conservation Objectives – Re-establish and maintain spring Chinook salmon populations in the Hood River Subbasin and maintain genetic and life-history diversity of re-established population.

Performance Standard (13): Broodstock collection does not reduce potential juvenile production in natural rearing areas.
Indicator 13 (a): Percentage of natural origin fish taken for broodstock comprises 10% of the brood population.

Performance Standard (14): Weir / trap operations do not result in significant stress, injury or mortality in natural populations.
Indicator 14 (a): Adult trapping mortality rate does not exceed 5% of catch.
Indicator 14 (b): Adult traps are checked daily when in operation.

Performance Standard (15): Broodstock selection strategies effectively maintain genetic and life history characteristics in the hatchery population.
Indicator 15 (a): Percentage of natural origin fish in the broodstock comprises at least 10% of the hatchery brood.
Indicator 15 (b): Timing of hatchery adult returns to the West Fork trap mimics natural origin spring Chinook returns.
Indicator 15 (c): Size and age composition of returning adults is consistent with the natural origin run over time.

Performance Standard (16): Broodstock collection does not significantly alter spatial and temporal distribution of naturally spawning spring Chinook salmon spawning populations.
Indicator 16 (a): Number of adult fish spawning immediately below the adult weir does not exceed historical distributions of spawning activity.
Indicator 16 (b): Natural origin spring Chinook salmon are captured and sorted and either retained for broodstock or passed upstream according to annual run timing and run size.

Ecological Impacts
Performance Standard (17): Release numbers do not exceed habitat capacity for rearing in the West Fork Hood River.
Indicator 17 (a): Smolts are released during March through April to promote smolt emigration.
Indicator 17 (b): Proportion of non-migrant hatchery smolts in natural rearing areas does not exceed 10% of release group.
Indicator 17(c): Emigration behavior of hatchery smolts matches that of their wild counterparts.

Performance Standard (18): Water withdrawals and diversion structures used in operation of Parkdale Fish Facility and Moving Falls acclimation ponds do not prevent

access to natural spawning areas, affect behavior of listed populations or affect juvenile rearing.
Indicator 18 (a): Water withdrawals compared to applicable passage criteria.
Indicator 18 (b): Water withdrawals compared to NOAA juvenile screening criteria.
Indicator 18 (c): Instream flows between facilities' intakes and out-falls are maintained.

Performance Standard (19): Predation by artificially produced fish on naturally produced fish does not significantly reduce numbers of naturally produced fish.
Indicator 19 (a): Size at, and time of smolt release compared to size and timing of natural fish present.

Monitoring and Evaluation
Performance Standard (20): Monitoring and evaluation occurs on an appropriate schedule and scale to assess progress toward achieving program objectives and evaluating the beneficial and adverse effects on natural populations.
Indicator 20 (a): Monitoring framework includes detailed design and timeline.
Indicator 20 (b): Annual and final reports.

Performance Standard (21): Hatchery produced spring Chinook salmon are marked to allow evaluation of effects on natural populations and determine harvest rates.
Indicator 21 (a): A minimum of one visible mark (Ad-clip) and CWT on all hatchery produced fish.
Indicator 21 (b): A representative sample of release groups fitted with PIT tags.

1.10) List of program "Performance Indicators", designated by "benefits" and "risks."

1.10.1) "Performance Indicators" addressing benefits.
Refer to section 1.9

1.10.2) "Performance Indicators" addressing risks.
Refer to section 1.9

1.11) Expected size of program.
Current spring Chinook salmon in the Hood River basin is 125,000 Hood River (Deschutes stock) of which 30,000 smolts are acclimated and volitionally released into the Middle Fork at the Parkdale Fish Facility and 95,000 smolts are volitionally released from West Fork acclimation sites each spring.

Revised program: Release 150,000 smolts from an acclimation facility located in the West Fork Hood River at Moving Falls (Rm. 2.5) beginning during 2010. Program size will be re-evaluated during 2018.

1.11.1) Proposed annual broodstock collection level (maximum number of adult fish).
Broodstock needs for the current 125,000 smolt program are 167 adults. All brood consists of hatchery returns. Under the revised program full production of 150,000 smolts will require 200 adults of which a minimum of 10% will consist of NOR adults.

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location.

Current Program through 2009:

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry		
Fingerling		
Yearling	West Fork Hood River at two sites: Middle Fork Hood River at one site:	95,000 spring Chinook salmon smolts 30,000 spring Chinook salmon smolts

Revised program beginning 2010:

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry		
Fingerling		
Yearling	West Fork Hood River at Moving Falls (Rm. 2.5)	150,000 spring Chinook salmon smolts

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

Table 1 summarizes the estimated smolt to adult returns of natural and hatchery reared spring Chinook salmon to Hood River at Powerdale Dam. Table 2 summarizes the spring Chinook salmon returns to Powerdale Dam Fish Trap.

Table 1. Jack and adult spring Chinook salmon escapements to the Powerdale Dam trap by origin, stock, brood year, and total age. (Percent return is in parentheses. Brood years are boldfaced for those years in which brood year specific estimates of escapement are complete. Estimates are based on returns in the 1992-2006 run years.) Data source: Olsen (2007).

Origin, Stock, Brood Year[a]	Smolt Production	**Total Age** Age 2	Age 3	Age 4	Age 5	Age 6
Natural,						
Hood River,[b]						
1986	--	--	--	--	--	0
1987	--	--	--	--	4	0
1988	--	--	--	32	18	1
1989	--	--	1	23	11	0
1990	--	0	1	19	13	0
1991	--	1	2	3	2	0
1992	--	1	4	89	42	1
1993	--	0	4	30	37	0
1994	--	2	1	30	5	0
1995	--	14	13	14	3	0
1996	--	5	5	57	12	0
1997	--	1	6	24	21	0
1998	--	3	8	49	51	3
1999	--	2	2	45	17	2
2000	--	1	15	110	47	3
2001	--	2	14	57	39	--
2002	--	7	10	255	--	--
2003	--	1	4	--	--	--
2004	--	1	--	--	--	--
Subbasin hatchery,						
Carson,						
1986	149,939	--	--	--	--	0
1987	134,047	--	--	--	18 (0.01)	0
1988	197,988	--	--	396 (0.20)	233 (0.12)	0
1989	125,432	--	3 (.002)	213 (0.17)	17 (0.01)	1 (.001)
1990	163,295	0	15 (.009)	244 (0.15)	35 (0.02)	0
Deschutes,[c]						
1991	75,205	4 (.005)	5 (.007)	27 (0.04)	2 (0.003)	--
1992[d]	0	--	--	--	--	--
1993	170,004	4 (.002)	15 (0.01)	280 (0.16)	3 (0.002)	--
1994	123,230	0	1 (0.001)	12 (0.01)	0	0
1995	100,719	11 (0.01)	2 (0.002)	88 (0.09)	2 (0.002)	0
1996	123,760	14 (0.01)	5 (0.004)	18 (0.01)	0	0
1997	121,348	183 (0.15)	128 (0.15)	560 (0.46)	20 (0.02)	1 (0.001)
1998	136,926	918 (0.67)	496 (0.36)	1,009 (0.74)	133 (0.10)	0
1999	124,679	32 (0.03)	24 (0.02)	199 (0.16)	14 (0.01)	1 (0.001)
2000	86,948	11 (0.01)	15 (0.02)	138 (0.16)	8 (0.01)	(0.001)
2001	126,363	14 (0.01)	182 (0.14)	578 (0.46)	66 (0.05)	--
2002	128,006	168 (0.13)	76 (0.06)	856 (0.67)	--	--
2003	113,036	71 (0.06)	36 (0.03)	--	--	--
2004	142, 014	184 (0.13)	--	--	--	--

[a] Complete brood returns are available beginning with the 1990 natural and 1989 hatchery broods, as determined based on age structure for jack and adult spring Chinook salmon sampled at the Powerdale Dam trap. Estimates of escapement for prior brood years do not include returns from all possible age categories.

[b] Developed from Deschutes and Carson stock hatchery production releases.

[c] Beginning with the 1994 brood release, hatchery smolts were volitionally released from acclimation facilities located in the Hood River subbasin. Hatchery smolts were held at the facilities for approximately two weeks prior to release.

[d] No hatchery fish were released from the 1992 brood.

Table 2. Bi-monthly counts of adult Hood River wild and hatchery spring Chinook salmon captured at Powerdale Fish Trap,1992-2006.

Natural

	April		May		June		July		August		September		October		
	1-15'	16-30'	1-15'	16-31'	1-15'	16-30'	1-15'	16-31'	1-15'	16-31'	1-15'	16-30'	1-15'	16-31'	Total
1992	0	0	1	8	5	11	4	4	0	0	0	1	0	0	34
1993	0	0	1	4	3	9	6	7	2	6	2	0	0	0	40
1994	0	0	1	5	0	1	3	8	1	2	0	12	0	0	33
1995	0	0	0	2	4	2	4	4	0	0	1	1	0	0	18
1996	0	0	1	7	50	4	9	3	8	6	1	0	0	0	89
1997	0	0	1	8	29	14	5	6	5	0	0	0	0	0	68
1998	0	0	3	7	18	8	5	7	2	2	6	16	3	0	77
1999	0	0	0	0	1	4	4	1	1	1	4	7	0	0	23
2000	0	0	3	10	6	13	9	2	0	12	5	4	0	0	64
2001	0	0	1	13	6	1	2	5	2	3	5	3	0	0	41
2002	0	0	0	5	6	13	9	14	12	6	5	0	0	0	70
2003	0	1	9	15	17	9	17	15	6	6	5	1	0	0	101
2004	0	3	10	14	9	23	6	16	13	5	6	27	4	0	136
2005	0	1	23	34	12	17	7	12	1	1	2	0	1	0	111
2006	0	0	10	108	84	55	18	15	2	2	3	0	0	1	298
Total	0	5	64	240	250	184	108	119	55	52	45	72	8	1	1203

Hatchery	April		May		June		July		August		September		October		
	1-15'	16-30'	1-15'	16-31'	1-15'	16-30'	1-15'	16-31'	1-15'	16-31'	1-15'	16-30'	1-15'	16-31'	Total
1992	0	9	77	145	75	62	15	4	4	1	2	2	1	0	397
1993	0	1	25	205	89	51	51	15	4	9	5	0	0	0	455
1994	0	6	33	165	28	7	4	17	1	0	1	1	0	0	263
1995	0	0	0	6	28	10	9	1	0	0	0	0	0	0	54
1996	0	0	0	0	10	4	1	0	0	0	0	0	0	0	15
1997	0	0	1	33	107	65	34	6	15	8	0	0	0	0	269
	April		May		June		July		August		September		October		
	1-15'	16-30'	1-15'	16-31'	1-15'	16-30'	1-15'	16-31'	1-15'	16-31'	1-15'	16-30'	1-15'	16-31'	Total
1998	0	0	1	1	10	1	2	0	0	0	0	0	0	0	15
1999	0	0	0	20	30	11	8	6	4	6	2	0	0	0	87
2000	0	1	6	58	58	19	4	0	0	2	0	0	0	0	148
2001	0	23	76	595	193	70	67	6	7	10	3	0	0	0	1050
2002	0	0	50	276	417	210	63	14	7	1	3	0	0	0	1041
2003	0	0	92	145	58	12	11	1	1	4	1	1	0	0	326
2004	0	4	36	48	89	56	6	7	1	10	3	0	0	0	260
2005	0	9	241	257	79	46	9	2	2	1	2	0	0	0	648
2006	0	0	21	236	341	242	23	16	7	16	24	0	0	0	926
Total	0	53	659	2190	1612	866	307	95	53	68	46	4	1	0	5954

1.13) Date program started (years in operation), or is expected to start.
Release of Deschutes stock into the Hood River began with the 1992 brood (1994 smolt release). The revised program will begin with smolt release of Hood River origin stock during 2010 from the 2008 brood.

1.14) Expected duration of program.
The Hood River spring Chinook salmon program is ongoing.

1.15) Watersheds targeted by program.
Hood River, Oregon. HUC 17070105

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.
The original program goal was to release 250,000 smolt as stated in the 2000 HGMP. The spring Chinook smolt release goal was reduced from 250,000 to 125,000 in consideration of limitations of rearing infrastructure and the potential interactions with the native steelhead population present in the subbasin (CTWS and ODFW 2000). The spring Chinook smolt release goals were refined in the Hood River/Pelton Ladder Master Agreement (ODFW and CTWS undated).

As part of the Master Plan revision process several alternatives to reaching program goals were evaluated ranging from the status quo to full in-basin production at a privately operated facility and Parkdale Fish Facility. Because many uncertainties remained about the abilities to conduct all fish culture activities in basin the co-managers have decided to conduct hatchery evaluation studies beginning in BY 2008. The results will provide logistical, biological and economic information that will allow managers to decide the most biologically sound and cost effective approach for conducting spring Chinook hatchery operations within the Hood River basin.

<u>SECTION 2. PROGRAM EFFECTS ON NMFS ESA-LISTED SALMONID POPULATIONS</u>. (USFWS ESA-Listed Salmonid Species and Non-Salmonid Species are addressed in Addendum A)

2.1) List all ESA permits or authorizations in hand for the hatchery program.
Activities associated with the existing HRPP have been authorized by ESA Section 10 Permits (#899).

The Hood River Production Program is included in the NMFS Section 7 consultation biological opinion entitled: “Biological Opinion on Artificial Propagation in the Columbia River Basin – Incidental take of listed salmon and steelhead from federal and non-federal hatchery programs that collect, rear and release unlisted fish species” (March 3, 1999).

2.2) Provide descriptions, status, and projected take actions and levels for NMFS ESA-listed natural populations in the target area.

Hood River steelhead are listed as "Threatened" under the Endangered Species Act. They are included in the Lower Columbia River Evolutionary Significant Unit (ESU). Both a summer and winter race of steelhead is indigenous to the basin.

2.2.1) <u>Description of NMFS ESA-listed salmonid population(s) affected by the program.</u>

Wild winter steelhead are believed to begin entering the Hood River subbasin around the last two weeks of December and the first two weeks of January (Olsen 2004). The run rapidly increases throughout March, peaks in late April, and then rapidly declines in May. Migration to the Powerdale Dam Fish Trap is completed by late June (Olsen 2007).

Wild summer steelhead begin entering the Powerdale Dam trap during late February to early March, and a given run year encompasses two calendar years for both components of the run. The median migration date past Powerdale dam typically occurs from early June to late September (Underwood et al. 2003). Migration to the Powerdale Dam Fish Trap is completed by late April to late May of the second calendar year. Pre-spawning adults remain in the river from the time of their arrival (March-November) until spawning the following spring (May-June).

Winter steelhead spawn primarily in the mainstem, Middle Fork, and East Fork of the Hood River while summer steelhead spawn in the West Fork (Coccoli 2004). The wild summer steelhead adult population enumerated at Powerdale Dam Fish Trap has ranged in size from 168 to 707 (mean 316) in the last five years (2002-2006). The wild winter steelhead population has ranged in size from 344 to 1,059 (mean 642) in the last five years (Olsen, 2007).

- Identify the NMFS ESA-listed population(s) that will be <u>directly</u> affected by the program.

Lower Columbia ESU steelhead.

- Identify the NMFS ESA-listed population(s) that may be <u>incidentally</u> affected by the program.

Lower Columbia ESU steelhead.

2.2.2) <u>Status of NMFS ESA-listed salmonid population(s) affected by the program.</u>

- **Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds** (*see definitions in "Attachment 1").*

An average annual escapement of 100 wild summer and 200 wild winter steelhead is the interim "critical" population threshold for Hood River steelhead. No "viable" population threshold has been identified for this population.

The wild summer steelhead adult population enumerated at Powerdale Dam Fish Trap has ranged in annual size from 176 to 266 (mean 216) in the last five years. The wild winter steelhead population has ranged in annual size from 345 to 745 (mean 525) in the last five years (Olsen, 2008)(Table 4).

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.
Extensive data has been collected during implementation of the HRPP. Complete annual data summaries are available upon request. Annual reports are available on the BPA website and are cited as:

Olsen, E.A. 2008. Hood River and Pelton Ladder evaluation studies. Annual Report 2007 of the Oregon Department of Fish and Wildlife (Project Number 1988-053-04) to Bonneville Power Administration, Portland, Oregon.

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.
Spawning escapement estimates are available for Hood River Subbasin ESA listed salmonids since 1992. Table 4 summarizes spawner escapement for listed summer and winter steelhead upstream from Powerdale Dam (RM 4.0).

Table 3. Adult summer and winter steelhead escapements to Powerdale trap by ocean age and brood year. (Percent smolt to adult return is in parenthesis. Brood years are bold faced in which brood year specific estimates of escapement are complete). Data source: Olsen (2007)

Wild Summer Steelhead		Ocean Age				Repeat
	Smolts	1 salt	2 salt	3 salt	4 salt	Spawners
1992	-	16	142	7	0	10
1993	1,178	8 (0.68)	60 (5.09)	16 (1.36)	0	8 (0.68)
1994	2,803	9 (0.32)	93 (3.32)	21 (0.75)	0	14 (0.50)
1995	5,679	19 (0.33)	169 (2.98)	10 (0.18)	1 (0.02)	14 (0.25)
1996	3,911	32 (0.82)	139 (3.55)	28 (0.72)	0	28 (0.72)
1997	8,815	61 (0.69)	498 (5.65)	54 (0.61)	0	39 (0.44)
1998	4,063	89 (2.19)	379 (9.33)	17 (0.42)	0	23 (0.57)
1999	1,994	68 (3.41)	187 (9.38)	17 (0.85)	0	10 (0.50)
2000	3,412	52 (1.52)	178 (5.22)	11 (0.32)	0	8 (0.23)
2001	3,437	28 (0.81)	108 (3.14)	13 (0.38)	0	0
2002	-	47	77	4	-	1 (0.02)
2003	-	24	9	-	-	-

Wild Winter Steelhead		Ocean Age				Repeat
	Smolts	1 salt	2 salt	3 salt	4 salt	Spawners
1992	-	29	209	40	0	11
1993	4,261	21 (0.49)	228 (5.35)	54 (1.27)	0	13 (0.31)
1994	4,486	15 (0.33)	157 (3.50)	40 (0.89)	1 (0.02)	10 (0.22)
1995	7,644	15 (0.02)	195 (2.55)	56 (0.73)	1 (0.01)	35 (0.46)
1996	22,538	55 (0.24)	911 (4.04)	153 (0.68)	0	142 (0.63)
1997	13,889	21 (0.15)	788 (5.67)	168 (1.21)	0	40 (0.29)
1998	7,286	30 (0.41)	678 (9.31)	197 (2.70)	1 (0.01)	36 (0.49)
1999	3,774	25 (0.66)	495 (13.1)	99 (2.62)	0	24 (0.64)
2000	5,888	12 (0.20)	409 (6.95)	86 (1.46)	2 (0.03)	6 (0.00)
2001	8,696	9 (0.10)	300 (3.45)	85 (0.98)	0	13 (0.15)
2002	-	10	231	2	-	0
2003	-	30	6	-	-	-

Table 4. Hood River spawner escapement upstream from Powerdale Dam, 1991-2007 run years. Data source: Olsen (2008).

Summer Steelhead	Run Year	Wild	Subbasin Hatchery
	1992-1993	489	1,722
	1993-1994	243	1,105
	1994-1995	217	1,623
	1995-1996	131	519
	1996-1997	179	1,307
	1997-1998	65	448
	1998-1999	98	4
	1999-2000	147	2
	2000-2001	180	1
	2001-2002	414	124
	2002-2003	543	500
	2003-2004	182	205
	2004-2005	152	171
	2005-2006	170	136
	2006-2007	169	174
	2007-2008	120	128
Winter Steelhead	Run Year	Wild	Subbasin Hatchery
	1991-1992	618	284
	1992-1993	345	10
	1993-1994	300	5
	1994-1995	161	5
	1995-1996	210	161
	1996-1997	238	252
	1997-1998	182	174
	1998-1999	255	188
	1999-2000	865	224
	2000-2001	877	656
	2001-2002	950	683
	2002-2003	654	412
	2003-2004	507	570
	2004-2005	273	246
	2005-2006	342	299
	2006-2007	423	364

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.
Refer to Table 4

2.2.3) <u>Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of NMFS listed fish in the target area, and provide estimated annual levels of take</u> *(see "Attachment 1" for definition of "take")***.**
All adult anadromous migrants are trapped and bio-sampled at the Powerdale Dam Fish Trap. Fish are tagged with individually numbered external tags, length / weight data, and scales are collected from each fish. Steelhead also have a small piece of the caudal fin removed for genetics monitoring. Fish are spilled from a "fish lift" directly into an anesthetic tank, equipped with a carbon dioxide system, prior to handling. At least 75% of the wild steelhead are passed upstream of Powerdale Dam to continue their migration and spawn naturally. Powerdale trap operations will continue until decommissioning during the summer, 2010.

Beginning in 2011 adult spring Chinook brood stock will be collected in the West Fork of the Hood River at Moving Falls. The trap will be operated daily during the spring through mid-summer. Adult summer steelhead are likely to be captured during trapping operations. They will be anesthetized and bio sampled before being released upstream. No winter steelhead should be captured in the Moving Falls trap.

Downstream migrant "screw traps" are operated in the mainstem and major tributaries from March through October to monitor and estimate total natural and hatchery smolt emigration. These traps typically sample 5 to 10% of the downstream migrants passing a particular trap. Captured migrants are held in a live-box before they are anesthetized, bio-sampled and released. A small number of captured migrants are marked and released upstream to provide trap efficiency data. Screw trap operations will remain the same during the current and revised program.

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.
Hatchery broodstock collection occurs as one task during the operation of the Powerdale Dam Fish Trap. Powerdale Dam may result in some migration delay for adult salmonids that have difficulty locating the fish ladder entrance. The ability of fish to find the ladder entrance is inversely proportional to river discharge. The trap operation briefly delays upstream migration.

Fish processed through the Powerdale Dam Fish Trap are handled which may result in slight scale loss or abrasions, and rarely a mortality. Listed fish released upstream of the dam have a quiet recovery area in which to recuperate from the handling and anesthetic. Fish must be thoroughly revived before they can find their way into the main portion of the Powerdale Dam forebay. Rarely fish are recaptured at the trap after being washed over the spillway.

There is no indication that handling of listed fish at Powerdale Dam Fish Trap results in significant spawning delays.

When trapping operations commence at Moving Falls it is likely that significantly fewer steelhead will be handled. This is because no winter steelhead will be captured due to run timing differences and their preference for spawning in different tributaries. While some summer steelhead will be captured the seasonal operation of the trap will preclude capture of the entire summer steelhead run destined for spawning habitat upstream of Moving Falls in the West Fork..

- Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.

Table 5 presents a summary of the annual number of steelhead collected for broodstock and associated mortality. The winter and summer steelhead broodstock currently consists of 100% wild returns. Pre-spawning mortality for summer and winter steelhead has dropped dramatically since fish have been held in the cold water at the Parkdale Fish Facility.

Summer steelhead angling occurs during the time when adult spring Chinook salmon are in Hood River. It is possible a few listed Hood River wild summer steelhead could suffer mortality after they are incidentally captured by salmon anglers. However, under Oregon state regulations, harvest of unmarked steelhead is not allowed in Hood River. Incidental or targeted harvest of steelhead by tribal members has not been documented in the Hood River.

- Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

Refer to the following “Take Tables” (Tables 5-6) for winter steelhead and summer steelhead.

Table 5. Estimated levels of wild steelhead "take" during juvenile migrant monitoring.

<table>
<tr><td colspan="5">Listed species affected: _Steelhead__ ESU/Population: Lower Columbia Activity:_ Hood River Production Program – Monitoring and Evaluation (natural and hatchery smolt emigration)_</td></tr>
<tr><td colspan="5">Location of hatchery activity:_ Downstream migrant trapping___ Dates of activity:_ Spring - Fall _
Hatchery program operator:_ Oregon Department of Fish and Wildlife</td></tr>
<tr><td rowspan="2">Type of Take</td><td colspan="4">Annual Take of Listed Fish By Life Stage (<u>Number of Fish</u>)</td></tr>
<tr><td>Egg/Fry</td><td>Juvenile/Smolt</td><td>Adult</td><td>Carcass</td></tr>
<tr><td>Observe or harass a)</td><td>0</td><td><2,000</td><td>NA</td><td>NA</td></tr>
<tr><td>Collect for transport b)</td><td>0</td><td>0</td><td>NA</td><td>NA</td></tr>
<tr><td>Capture, handle, and release c)</td><td><500</td><td><2,000</td><td>NA</td><td>NA</td></tr>
<tr><td>Capture, handle, tag/mark/tissue sample, & released)</td><td>0</td><td>0</td><td>NA</td><td>NA</td></tr>
<tr><td>Removal (e.g. broodstock) e)</td><td>-</td><td>-</td><td>NA</td><td>NA</td></tr>
<tr><td>Intentional lethal take f)</td><td>-</td><td>-</td><td>NA</td><td>NA</td></tr>
<tr><td>Unintentional lethal take g)</td><td><50</td><td>< 120</td><td>NA</td><td>NA</td></tr>
<tr><td>Other Take (specify) h)</td><td>-</td><td>0</td><td>NA</td><td>NA</td></tr>
</table>

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.

Table 6. Estimated levels of adult wild steelhead "take" during adult trapping operations. .

Listed species affected: _ Steelhead__ ESU/Population: Lower Columbia____ Activity:_ Hood River Production Program – Supplementation of wild population_				
Location of hatchery activity:_ Powerdale Dam Fish Trap / Parkdale Fish Facility___ Dates of activity:_ Year around _ Hatchery program operator:_ Oregon Department of Fish and Wildlife / Confederated Tribes of Warm Springs Reservation of Oregon_				
	Annual Take of Listed Fish By Life Stage (*Number of Fish*)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)	-	-	<1,000	0
Collect for transport b)	-	-	-	<20
Capture, handle, and release c)	-	-	-	NA
Capture, handle, tag/mark/tissue sample, and released)	-	-	-	NA
Removal (e.g. broodstock) e)	-	-	-	NA
Intentional lethal take f)	-	-	-	NA
Unintentional lethal take g)	-	-	<10	NA
Other Take (specify) h)	-	-	-	NA

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

Powerdale and Parkdale Fish Facility physical components and fish handling procedures are modified immediately if any appreciable fish mortality is observed. Project personnel will immediately notify PacifiCorp if any salmonid mortalities appear related to Powerdale Dam operation or facilities.

Both adult and juvenile trapping will immediately cease if mortalities exceed take levels. An investigation will be conducted to determine the cause of mortality and a remedy will be identified.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

The current and revised program is fully integrated into the Hood River Subbasin Plan and Hood River Subbasin Management Plan (NWPPC, 2004) and Columbia River Basin Fish and Wildlife Program (NPPC 1987). Program goals are consistent with the WY-KAN-USH-MI WA-KISH-WIT (The Columbia River anadromous fish restoration plan of the Nez Perce, Umatilla, Warm Springs, and Yakima Tribes). The Revised program will be fully aligned with APRE (2004) and HSRG (2007) recommendations for integrated hatchery programs.

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

This program operates under the Hood River Master Plan, Hood River/Pelton Ladder Master Agreement, Hood River EIS and the Salmon and Steelhead Production Plan for the Hood River Subbasin (System Plan). The program is included in the *US vs. Oregon* Hatchery Production tables (2007) and is consistent with the1855 Treaty with the Tribes of Middle Oregon (12 stat. 963).

3.3) Relationship to harvest objectives.

All spring Chinook salmon available for harvest have an adipose fin clip. In-river harvest is permitted when pre-season run forecasts indicate there will be fish in excess of escapement and hatchery broodstock needs. Regulatory mechanisms are in place to close the fishery mid-season if broodstock and escapement goals are not being met. Tribal and sport fisheries are creeled during open seasons.

Spring Chinook salmon fisheries in the Hood River have been opened only during four run years since 2000 due to low run size predictions. Current hatchery operations are not consistently meeting in-river harvest objectives.

Beginning during 2010 smolt releases will increase from 125,000 to 150,000. This coupled with increased smolt to adult survival expected from full in-basin rearing and ongoing habitat restoration should result in approximately 1,300 hatchery adults for harvest on an annual basis. As fisheries are more consistently opened we expect a significant increase in tribal / sport harvest interest.

3.3.1) Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.

Hatchery origin spring Chinook salmon provide tribal and sport in-river and mainstem harvest opportunities. In-river exploitation has averaged approximately 12% since 2000 when fisheries have been permitted. Mainstem Columbia River combined commercial / sport exploitation rates have averaged 14% from 1998-2004 based on CWT recoveries.

Data from mainstem tribal subsistence and ceremonial fisheries is not available but it is likely that Hood River spring Chinook salmon contribute to those fisheries as well.

3.4) Relationship to habitat protection and recovery strategies.

Native spring Chinook salmon were extirpated in Hood River in the 1960s. Likely factors contributing to their demise include destruction of spawning and rearing habitat through historical timber harvest (splash damming, clear cutting, etc.) and irrigation/hydroelectric water withdrawals. Unscreened water withdrawals at several irrigation diversions and particularly at Powerdale Dam penstock likely played a large role in the decline of anadromous fish within the basin.

Major limiting factors for natural production are believed to occur at the egg-to-smolt lifestage. Egg-to-smolt survival has been roughly estimated at 0.55%. The lack of pools, cover, and stable spawning gravel have all been identified as causative factors for the low juvenile survival rate.

Since inception of the HRPP, several key habitat restoration activities have occurred. Major irrigation diversions have been screened to NOAA standards. Hyrdoelectric water withdrawal was permanently ceased during 2006. Instream and upslope restoration activities have been implemented by several agencies to restore natural processes and channel complexity. Fish passage has been restored through culvert improvement in several tributaries. During 2010, Powerdale Dam will be decommissioned thereby easing adult and juvenile passage.

Agencies, irrigation districts, and concerned public cooperatively work together through the Hood River Watershed Group to coordinate restoration efforts and funding. A holistic watershed approach is under implementation with specific projects identified in the Hood River Action Plan (Cocolli, 2002). The habitat restoration component of the HRPP is actively engaged in habitat restoration activities that address limiting factors to anadromous salmonid production. Current and future activities include fish screening, flow restoration through irrigation ditch piping, fish passage, and instream/riparian restoration. Approximately $700,000 is expended annually by the CTWSRO/BPA for these habitat restoration activities. Other significant funding is provided by OWEB and the USFS.

A modeling exercise completed by Cramer and Associates during 2004 predicted that the net benefit of the current and planned restoration activities should increase natural spring Chinook salmon smolt production by 20,000 smolts (Cramer et al. 1994).

3.5) Ecological interactions.

The HRPP spring Chinook salmon hatchery program has the potential to affect wild steelhead in a number of ways including predation, competition, and disease. However, little evidence exists of predation or competition by hatchery released spring Chinook salmon on other salmonids.

Release timing and methods (spring smolt release following acclimation) are intended to result in rapid migration from the Hood River and limit interaction with other species in the river. Fish that do not migrate volitionally are transported to the mouth of the Hood River in order to prevent residualism. The limited time for conversion from a hatchery diet to a natural diet further reduces the likelihood of predation by hatchery fish on other salmonids. There is the potential for predation by other salmonids, especially bull trout, on hatchery and natural spring Chinook salmon in the Hood River basin.

Hatchery smolts have the potential to compete with wild steelhead for food, space and habitat in the migratory corridors. If interaction does occur it is likely to be of short duration as smolts move downstream and out of the basin rapidly. Recent PIT tag data suggests mean travel time from release to detection at Bonneville Dam for hatchery smolts is twenty-five days (Gerstenberger 2008).

Hatchery operations potentially amplify and concentrate fish pathogens and parasites that could affect wild steelhead growth and survival. Because the current program rears hatchery spring Chinook salmon out of basin, the potential disease impacts to wild salmonids are limited to periods of adult holding, spawning and smolt acclimation. When full term rearing occurs in the Hood River basin, as proposed in the revised program, the potential for disease transmission will increase. Documentation of disease status is and will continue to be accomplished through monthly and pre-liberation fish health examinations.

Broodstock collection at Powerdale Dam and at Moving Falls weir, after Powerdale Dam is decommissioned, potentially affects adult wild salmonids. These facilities may temporarily delay migration and some handling occurs. However, the traps will be checked daily. The Moving Falls weir will collect steelhead kelts for enumeration before being immediately passed downstream.

SECTION 4. WATER SOURCE

4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

The current Hood River spring Chinook program involves three facilities with different surface water supplies. The facilities include Parkdale Fish Facility, Round Butte Fish Hatchery and Pelton Ladder. Water source and facility information for Rounde Butte Fish Hatchery and Pelton Ladder is described in the Round Butte Fish Hatchery HGMP (ODFW, 2004).

The Parkdale Fish Facility (PFF) presently has two water sources. Rogers Creek supplies the facility with spring water at a constant 39-42°F temperature. Middle Fork Irrigation District supplies irrigation water to the facility from Lawrence Lake, Coe or Elliot tributaries to the Middle Fork. Water temperatures vary from 33-55°F. Rogers Creek is an excellent water source for adult broodstock and incubating. It is believed to be pathogen free. Water from the Middle Fork Irrigation District, on the other hand, experiences large amounts of glacial turbidity during the warm summer months. PFF uses both water supplies at different times of the year depending on the purpose, such as lowering water temperatures to hold adult brood and reduction of disease potential, or elevating water temperatures to allow maturation of adults. Generally, water temperatures are set to reflect those found in the West Fork and Middle Fork. The PFF has a state water right for a combined withdrawal of 5.59 cfs. A NPDES permit is not needed because it is below the minimum standard. All water intakes are screened to meet NOAA criteria.

After completion of the HRPP Master Plan Revision ground water from one well at PFF wells will be used for incubation and early rearing. Recent well monitoring suggests sustained yields of 280 gpm at 44.1 °F. Ground water rights for a maximum of 1010 gpm are being acquired. Part of the HRPP Master Plan Revision will involve building rearing ponds at the Moving Falls location. These ponds will be used for acclimation as well as rearing. Water from the West Fork will supply the rearing / acclimation ponds. Water temperatures in the West Fork Hood River range from the low 30's°F in the winter to the high 50's°F in the summer months. Up to 5 cfs of water will be diverted from the West Fork to supply the rearing / acclimation ponds.

4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.

Risk of take at the Parkdale Fish Facility is minimized because listed fish are not present in the reach of Rogers Creek upstream from the water diversion. Additionally a fish screen meeting NMFS criteria was installed the summer of 2000 at the Rogers Creek diversion intake.

An 8,000 gallon fish waste tank (FWT) is used to capture fish refuse from the spawn/incubation building. That material is periodically pumped into a sludge truck.

A fish screen meeting NMFS water withdrawal criteria will be installed at the proposed Moving Falls rearing / acclimation ponds intake. A pollution abatement pond or bio-swale will eliminate any suspended or settleable solids associated with smolt production. An ultra-violet or ozone system will eliminate potential fish pathogens.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Spring Chinook salmon broodstock are currently collected at Powerdale Dam Fish Trap located at RM 4.0 in Hood River. Construction of this facility was completed in 1997. Fish are captured after they ascend the fish ladder and jump over a finger weir into a 6x50 foot channel. Fish are manually crowded into a fish lift where they are brought into the sorting and processing building. Spring Chinook salmon are sorted and either passed upstream or taken for brood.

After completing the HRPP Master Plan Revision, Spring Chinook broodstock will be collected at the Moving Falls weir and transported to Parkdale Fish Facility. Similar procedures that are currently used at the Powerdale Dam Fish Trap will be utilized. The proposed trap will be a floating resistance board weir with a picket trap box that is operated seasonally.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

Broodstock are hauled from the Powerdale Dam Fish Trap to the PFF using a 500 gallon fiberglass tank with an aeration system which is mounted on a one-ton flatbed pickup. Up to 10 fish can be hauled safely per trip. The same truck will be used to transport broodstock from the Moving Falls Trap to PFF.

5.3) Broodstock holding and spawning facilities.

All of the broodstock presently used at Parkdale Fish Facility are delivered from Powerdale Dam Fish Trap and are held in one of two 8x40 foot concrete holding ponds. The water depth of the ponds is normally four feet and can be adjusted to desired levels. Brood holding ponds are supplied with water from either the Middle Fork Irrigation District or Rogers Creek or a combination of both. The water is gravity fed and is delivered through an underground piping system. The water can be adjusted for desired flows, but is normally set for 400 gpm for each pond. Pond water temperatures and depths are continually monitored by the Global Monitoring System (GMS), and Zetron Phone Dialer Pager (ZPDP). Flow meters monitor the ponds' inflow. The upper end of each pond is fitted with a slotted aluminum screen system. Spray bars deliver approximately 50 gpm to each pond for fish security and sun shading, and can use water from either source. The adult ponds are painted camouflage and shade cloth is attached to the perimeter railing. Adult salmon and steelhead are held in these ponds until they are spawned and/or released back to the Hood River. No adverse critical habitat is lost between the intake diversion and the discharge back to Rogers Creek.

The spawning building at Parkdale Fish Facility is located in close proximity to the adult holding ponds. The spawning building is approximately 18x18 feet. It is constructed of split face concrete block and has a metal roof. The building has an electrical supply and is plumbed with hot and cold water. All of the necessary supplies for spawning are located in this building. Emergency pumps to operate the adult pond spray bars are located in this building. Adult broodstock are handled and sorted prior to spawning in this building. A floor drain diverts spawning refuse to the 8,000 gallon fish waste tank.

5.4) Incubation facilities.

The incubation room is approximately 16x16 feet. It is a continuation of the spawning building and is constructed exactly as the spawning building. The building receives the same water from the same sources as the adult holding ponds. Gravity fed water from Rogers Creek or the Middle Fork Irrigation District supplies MariSource vertical stack incubators. There are presently eight stacks of incubators with eight trays per stack. Booster pumps and a GMS sensitive head box are plumbed to the incubators. Discharge water from the incubators is returned back to Rogers Creek. The two floor drains are plumbed to the 8,000 gallon fish waste tank. Green eggs can be incubated, hatched and held to the swim-up stage.

As part of the HRPP Master Plan Revision, PFF will be retrofitted with thermostatically controlled well water to be used for incubation and early rearing. To reduce water heating costs a 50 gpm water re-circulation system will be installed. The unit will be equipped with mechanical filtration and U.V. disinfection. Two additional vertical stack incubators will be installed. The incubation room will be re-plumbed to increase flow and to replace existing copper piping with PVC pipe.

5.5) Rearing facilities.

Fish are not currently reared at the Parkdale Fish Facility. Experimental rearing has been carried out on a limited basis, mainly to compare growth and smolt quality with Round Butte Hatchery. Presently any fish rearing occurring at this facility would have to be done in the smolt acclimation ponds. There are two 8x80 foot concrete acclimation ponds. These ponds are typically adjusted to a depth of four feet. Rearing of spring Chinook salmon fry may occur from July, when fish are about 100 fish/lb., through March the following year when fish are approximately 15 to 20 fish/lb. Water intakes are adjusted to furnish desired flows to the ponds. The facility will be retrofitted as part of the HRPP Master Plan Revision for early rearing of spring Chinook salmon. A series of six 21’x 3’x3’ Canadian rearing troughs will accommodate early rearing. Thermostatically controlled well water will be used for early rearing.

5.6) Acclimation/release facilities.

Spring Chinook salmon are currently acclimated and released from three sites in the Hood River subbasin. Two sites are located in the West Fork and one site at the Parkdale Fish Facility on the Middle Fork. These sites were chosen because of their close proximity to prime spawning and rearing habitat. The West Fork acclimation sites are at Blackberry Creek (RM 8.6) and at Jones Creek (RM 13.6). Up to three portable ponds are used at the two West Fork Hood River acclimation sites.

The Parkdale Fish Facility has two 8x80 foot acclimation ponds, which are typically adjusted to four-foot depths. Water is supplied from the same sources as the adult holding ponds. Water is delivered by gravity through underground pipes. Either Rogers Creek or Middle Fork Hood River water, or a combination of the two, is used for acclimation. Water depths and temperatures are constantly monitored by the GMS. ZPDP and flow meters monitor water flows. Maximum flows are set at 750 gpm per pond. The upper and lower ends of the ponds are fitted with slotted aluminum screens. The lower ends of the ponds are fitted with dam board channels which control the depth of the ponds. Both ponds are painted camouflage. Typically smolts are held here during acclimation for several weeks prior to a volitional release.

At Blackberry Creek, two ModuTank Ponds (RM 8.6) are supplied with about 400 gpm water from the nearby creek. The Jones Creek acclimation site (RM 13.6) has a single ModuTank Pond set up. The water supply is from Jones Creek, a small intermittent tributary of the West Fork.

Each pond measures 5’ tall x 12’ wide x 60' long and has a 19,500 gallon maximum capacity. The ponds consist of four foot galvanized steel panels, supporting frames and cables, a 36 mm reinforced polypropylene liner, and a six inch PVC bulkhead. Water for the Blackberry ponds was diverted from Blackberry Creek through a screened intake box and a 930 ft gravity flow pipeline of 8" pipe. The return flow back to the West Fork Hood River consists of 360 ft. of 8" pipe. Control valves regulate water at the intake box, the junction of the two ponds, and at each pond outlet. A four-foot high, six-inch diameter PVC standpipe is connected to the outlet bulkhead of each pond to control the water level. The standpipes are used to release fish and to drain the ponds when needed. The ponds are covered with a fine mesh net at both ends of the pond to prevent fish from jumping out, protect them from predators, and create shade refuge. A battery operated flotation alarm system is attached to each pond during acclimation. The alarm system sounds when the water level varies from a fixed level. The contact points of the alarm can be adjusted to trigger at various water depths. Smolts are volitionally released from the ponds through an aluminum hopper. The hopper is constructed with a rectangular "V" shaped bottom, three vertical sides, one open side and the "V" bottom connected to a six-inch diameter pipe. Each acclimation pond is equipped with a 200 gpm pump and an aerating system to re-circulate and aerate the pond water in the event of a water supply failure.

Each acclimation site is manned twenty four hours a day. Water temperatures, dissolved oxygen, and fish mortalities are recorded regularly during the acclimation period. After holding for a number of days (usually one week) the screens are removed and the fish are allowed to emigrate on their own volition.

With completion of the HRPP Master Plan Revision, all 150,000 spring Chinook smolts will be forced released at the Moving Falls rearing/ acclimation location. This will eliminate the PFF, Blackberry, and Jones Creek acclimation sites. The site will contain six 18.5' x 58' long concrete raceways. Up to four cfs of West Fork water will be collected at a screened intake structure upstream of the facility and delivered by gravity to a the ponds.

Beginning in 2010, pre-smolt from Pelton Ladder, Carson Hatchery and PFF will be delivered to acclimation facility. Fish will not exceed a density index of 0.16 in each pond.

While in the ponds site caretakers will perform daily scheduled fish culture duties that includes: checking the water intake and screens, recording oxygen, temperature and water levels in the rearing ponds three times each day, feeding the fish and picking fish mortalities. Staff will observe fish behavior for abnormalities and assist in fish health checks, bi-weekly sampling and PIT tagging. Feeding protocols and food type are to be determined.

The goal will be to release all fish into the West Fork Hood River by the end of April. If a high water event occurs during April the fish would be forcibly released to coincide with the freshet. If no such event occurs the fish will be forced released at month's end.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

In April 2000, the hatchery water supply (Rogers Creek Intake) was contaminated with a suspected roadside herbicide or an orchard spray. Approximately 3,000 of the 10,000 spring Chinook salmon sac-fry died that were being reared in the starter tank. Protective measures have been taken to prevent any further water quality problems of this type.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

PFF is staffed full-time, 24 hours per day. A computerized alarm system, GMS and ZPDP allows instantaneous notice of a system failure. Parkdale Fish Facility is equipped with a backup generator in case of an electrical failure. Since two water sources are currently available with a third coming on line at PFF it is possible to switch from one source to the other in the event of system failure. PFF staff follows established protocol to minimize any disease transmission at the facility. After completion of the HRPP Master Plan Revision, similar precautionary measures will be incorporated at the Moving Falls rearing site to minimize production loss or equipment failure.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to wild fish of the same species/population.

6.1) Source.

The Hood River spring Chinook salmon re-introduction program used Carson stock spring Chinook salmon for Hood River subbasin releases from 1986 to 1992. Deschutes stock spring Chinook salmon were used from 1993 to 1997. Since 1998 the PFF has used Hood River hatchery released spring Chinook (originally Deschutes stock) broodstock. During years when local broodstock needs are not met, Deschutes stock spring Chinook eggs from Round Butte Hatchery are used to make up the shortfall. After completion of the HRPP Master Plan Revision the goal will be to use 100% Hood River spawners returning to the Moving Falls weir. A minimum of 10% naturally produced adults will be incorporated into the broodstock.

6.2) Supporting information.

6.2.1) History.

Hood River spring Chinook salmon were extirpated in the late 1960s. The Hood River spring Chinook salmon re-introduction program used Carson stock spring Chinook salmon for Hood subbasin releases from 1986 to 1992. Deschutes stock spring Chinook salmon have been the designated donor stock since 1993. Since 1998, the PFF has strived to use hatchery origin Hood River spring Chinook (originally Deschutes stock) broodstock as much as possible. However Deschutes stock spring Chinook eggs from Round Butte Hatchery are used in years to meet production goals when hatchery origin Hood River spring Chinook returns are insufficient to meet escapement and broodstock goals. Naturally produced fish were incorporated in the 1997-1998 broods but have not been routinely incorporated into the broodstock due to low returns.

The Deschutes stock used at Round Butte Hatchery originated from wild spring Chinook salmon from the Warm Springs River. The Warm Springs River is a tributary to the Deschutes River that supports the sole remaining wild population of Deschutes River spring Chinook salmon. Currently, Round Butte collects hatchery origin returns at the Pelton Fish Trap, located on the Deschutes River at RM 100, for broodstock. This hatchery stock has been periodically supplemented with fish or eggs from Warm Springs River at the Warm Springs National Fish Hatchery stock (WSNFH).

Beginning with BY 2008 the program will use entirely Hood River origin broodstock that incorporates a minimum of 10% naturally produced adults.

6.2.2) Annual size.
Currently, no naturally produced fish are used for broodstock. The number of hatchery origin broodstock varies from 110 to 150 adults depending on run strength. Additionally, 10% of broodstock consists of jacks. Adult sex ratios are 50:50 female/male.

Beginning with the 2010 smolt release the spring Chinook smolt production will be increased to 150,000 from the current 125,000. The number of fish required for broodstock will increase to 180 fish at 50:50 female/male sex ratio. The goal will be to use 10% natural origin broodstock (9 females and 9 males).

6.2.3) Past and proposed level of natural fish in broodstock.
Spring Chinook salmon broodstock were collected from the Hood River subbasin (Powerdale Dam Fish Trap) in 1997 and 1998. Ninety unmarked, naturally produced fish were included in the 110 fish collected for broodstock in 1997; 36 unmarked, naturally produced fish were included in the 42 fish collected in 1998.

From 1999 to present, all spring Chinook broodstock collected from Hood River have been hatchery returns. For brood years 1999, 2000, and 2003, no spring Chinook brood were collected from the Hood River due to low returns. PFF relied exclusively on surplus eggs from Round Butte Hatchery to meet production goals.

Round Butte Hatchery incorporated between 10-15% natural origin adults into their broodstock during the 1990s. Since 2001, the broodstock has consisted solely of hatchery origin adults.

Beginning with the 2008 brood year, a minimum of ten percent of the broodstock will consist of natural origin returns. Natural origin brood will only be collected when the mean run to the river mouth estimates exceeds existing goals by 10%.

6.2.4) Genetic or ecological differences.
Because both natural and hatchery fish are of Deschutes origin and spawn together, it is unclear whether or not genetic divergence has occurred during the relatively short duration of this program. However some ecological differences are occurring.

A high rate of mini-jacking (up to 40%) of hatchery released smolts has occurred in some years. It is speculated that rearing fish in the Deschutes basin is largely responsible for this phenomena. Juveniles reared in the Pelton ladder experience accelerated growth due to warmer water and abundant feed than would be expected to occur in the Hood River.

It is likely that juvenile out migration timing differs since hatchery smolts are released as 1+ smolts during a three week period in the spring. The life history of naturally produced out migrants in the Hood River is not well understood but some out migration may occur during the fall. The adult natural origin mean return date to Powerdale trap is one month later (June) than for hatchery adults (May). Monitoring and evaluation efforts will be increased to determine if there is ecological divergence between the hatchery and naturally production.

The program hopes to minimize ecological differences by producing all hatchery spring Chinook salmon in the Hood River basin using entirely Hood River returns as broodstock beginning during BY 2008. The monitoring and evaluation program will focus on detecting any divergence of naturally produced fish from hatchery fish.

6.2.5) Reasons for choosing.
The Deschutes stock of spring Chinook salmon was selected as the donor stock for the re-establishment of spring Chinook salmon in the Hood subbasin because of its proximity to the Hood subbasin and the similarities of stream habitat in the Deschutes and Hood River tributaries. The Deschutes stock is found in the lower Deschutes subbasin, which borders the Hood subbasin along a portion of the southern and eastern boundaries. The Deschutes stock is a small race of Chinook that historically has used the small headwater tributary streams in the Warm Springs River system. These small headwater streams are located on the east face of the Cascade Mountains in a physical setting that is similar to the upper Hood River tributaries. Because of these habitat similarities and the availability of adults and eggs the Deschutes River spring Chinook were selected as the donor stock.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.
The indigenous Hood River spring Chinook salmon were extirpated in the late 1960s. The naturally produced spring Chinook salmon in the Hood subbasin are the progeny of introduced Deschutes stock. The program strives to use Hood River origin hatchery returns for broodstock while allowing sufficient numbers of adults to seed the natural habitat. Going forward, the program will begin incorporating natural origin returns into the broodstock.

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).
Hood River origin adults are collected at Powerdale Dam trap for broodstock. In years with insufficient returns, eggs are obtained from the Round Butte Hatchery. After Powerdale Dam is decommissioned in 2010, adults for broodstock will be collected at the Moving Falls fish trap in the West Fork Hood River.

7.2) Collection or sampling design.
Spring Chinook salmon are processed at the Powerdale Dam Fish Trap from late April through September. The facility is located well downstream of spawning habitat. The Powerdale Dam Fish Trap includes a finger weir trap that captures 100% of the Chinook

migrating through the Powerdale Dam fish ladder. Hatchery origin broodstock are collected in proportion to the mean five year run timing to avoid truncating the return of hatchery reared progeny. The same procedure will be implemented after Powerdale Dam is removed in 2010 and the new Moving Falls weir is operational.

7.3) Identity.

A spring and fall race of Chinook salmon are present in the Hood River. Spring Chinook are the target population. The run timing of both races does not overlap. Hood River origin broodstock are readily identifiable by the presence of two external fin marks (Ad –LV/RV) and a CWT.

7.4) Proposed number to be collected:

7.4.1) Program goal (assuming 1:1 sex ratio for adults):

Up to 150 spring Chinook salmon adult broodstock are collected to achieve the current smolt production goal of 125,000 smolts. The broodstock sex ratio is assumed to be approximately 1:1, although this is difficult to verify during broodstock collection because of the lack of distinctive sex-related external characteristics. Beginning with BY 2008 up to 200 brood (100 pair) will be needed to meet the production objective of 150,000 spring Chinook smolts.

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

Year	Adults Females	Males	Jacks	Eggs	Juveniles
1997	60	50	0	183,428	101,093
1998	24	18	0	56,669	124,783
1999	NA	NA	NA	NA*	121,419
2000	NA	NA	NA	NA*	102,765
2001	65	68	NA	180,954	120,901
2002	78	71	NA	190,679	101,009
2003	NA	NA	NA	NA*	126,353
2004	37	20	50	83,928**	128,256
2005	76	76	20	159,574	112,968
2006	110	119	6	124,387	113,779
2007	65	12	72	135,000**	127,829

*-Eggs from Round Butte Hatchtery (Deschutes River) were used.

** Due to high shock loss eggs from Round Butte Hatchery were used to supplement production.

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.

Spring Chinook salmon are collected for PFF broodstock at the Powerdale Dam Fish Trap. Only appropriate numbers of fish are collected for broodstock. The hatchery produced fish not selected for broodstock are passed upstream to support the tribal fishery and / or spawn naturally.

When spring Chinook broodstock collection begins at the Moving Falls Weir in 2010. hatchery origin adults in excess of broodstock and supplementation needs will be removed from the river and distributed to the tribes. If the re-introduced natural population is not able to support itself naturally, a portion of the excess hatchery adults may be passed upstream to supplement natural spawning.

7.6) Fish transportation and holding methods.

All fish captured at Powerdale Dam Fish Trap are anesthetized with CO_2 prior to sorting. Transport of fish passed upstream is via a watered 10" diameter tube to the fish ladder. Spring Chinook collected for brood are given an Erythromycin injection at 0.5 ml/fish prior to being transferred to a 10" watered tube that transports the fish into a truck mounted 500 gallon liberation tank. The tank is equipped with an oxygenation system that maintains adequate O_2 to fish in transit. The trip from Powerdale Dam Fish Trap to Parkdale Fish Facility is approximately 20 minutes (15 miles). The fish are delivered directly to the holding pond via a gate valve and trough. Spring Chinook salmon broodstock collected at the Powerdale Dam Fish Trap are transported as green fish to holding ponds at the Parkdale Fish Facility.

Similar procedures will be used to transfer green fish captured at the Moving Falls Weir to the Parkdale Fish Facility. Transit time will be approximately 30 minutes (12 miles).

7.7) Describe fish health maintenance and sanitation procedures applied.

Spring Chinook salmon broodstock receive two prophylactic injections of Gallimycin-100 (erythromycin) and Oxybiotic-100 (oxytetracycline hydrochloride) to help reduce the likelihood that bacterial kidney disease (BKD) and furunculosis will result in adult pre-spawning mortalities and reduce vertical transmission of the causative agent to the offspring. Broodstock receive regular treatments with formalin to prevent / control fungus *(Saprolegnia parasitica)* outbreaks. At spawning, all fish used for brood production will be examined for BKD using the enzyme linked immunosorbent assay (ELISA) and given a health exam. The spawning area and equipment are routinely disinfected with an iodophore solution to minimize disease outbreaks. Green eggs are water-hardened in an iodophore solution to prevent disease or viral contamination. Ovarian fluid, sperm, kidney and spleen samples are collected and cultured for BKD, furunculosis, IHN and other viral pathogens. Any BKD positive samples result in the culling of the eggs from those adults.

7.8) Disposition of carcasses.

Spawned, unspawned, and pre-spawning mortality spring Chinook salmon carcasses are frozen and placed in the facility dumpster. The carcasses are transferred to a land fill. Spring Chinook broodstock at PFF typically exceeds the IHN criteria established by ODFW Fish Health for carcasses to be used for stream nutrient enrichment. To minimize the risk of transmitting infections to wild populations, no adult salmonid carcasses are out planted from PFF.

When Moving Falls weir is operational, surplus hatchery fish will be placed in iced fish totes and transported to Warm Springs, Oregon, for distribution to tribal members or frozen for future use in tribal ceremonies.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

Naturally produced Hood River spring Chinook salmon are of hatchery origin and are not an ESA-listed population. Given the absence of genetic effects to listed steelhead from spring Chinook collection at Parkdale Fish Facility, basic safe fish handling techniques at the Powerdale Dam Fish Trap and at the Moving Falls trap during broodstock collection will minimize the ecological impacts on listed wild steelhead.

All broodstock are sampled for IHN, BKD and other pathogens as appropriate. Each egg batch is associated with individual fish and are discarded upon the discovery of IHN Type 2 or other disease.

SECTION 8. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1) Selection method.

The annual spring Chinook salmon run size is estimated based on the previous year's jack and 4-year-old counts made at the Powerdale Dam Fish Trap. Collection of spring Chinook salmon broodstock occurs in proportion to the five year average hatchery run timing. Individual fish are collected randomly at a given ratio throughout the run. Fish are spawned randomly as they ripen. With the removal of Powerdale Dam and the completion of the HRPP Master Plan Revision, collection of spring Chinook salmon broodstock will occur at the Moving Falls Weir. Run size estimates and broodstock collection procedures will continue as currently implemented. Results from radio telemetry studies during 2008-2009 will be used to determine run timing past the Moving Falls weir initially. Direct observations at the wier site will be used to estimate brood collection frequencies as the data becomes available.

8.2) Males.

There are no backup male broodstock. Jacks are included at approximately 10% in the broodstock and are used in the production egg takes.

8.3) Fertilization.

Spring Chinook salmon are spawned using a 1:1 (male to female) ratio. The individual family groups of eggs are kept separate in the incubators at PFF. Eggs from BKD positive parents will be culled from the production. Parents are wiped down with an iodine solution and bled prior to spawning. Ovarian fluid and sperm samples are collected for viral analysis. Fertilized eggs are water-hardened in an iodine solution prior to placement in incubators.

8.4) Cryopreserved gametes.

Cryogenic preservation of spring Chinook salmon gametes is not used in the Hood River Production Program.

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

HRPP spring Chinook salmon are not listed under the ESA. However, broodstock are selected at random from throughout the spring Chinook salmon run. Spawning is done randomly based on availability of ripe fish. Mating is done on a 1:1 sex ratio (i.e. one male and one female).

SECTION 9. INCUBATION AND REARING -

Specify any management *goals* (e.g. "egg to smolt survival") that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

The Hood River Production Program (HRPP) started spawning spring Chinook broodstock at PFF in 1998. Because of low adult returns no spring Chinook were collected for broodstock in 1999, 2000 and 2003. Egg survival from green to the eyed stage has varied from a high of 94% in 2001 to a low of 49% in 2005. The causes for the recent relatively low survival rate were investigated after the 2007 spawning. It was determined that hatchery personnel disinfected the eggs in a 100/ppm solution of idophore for 1 hour from 2004-2007. The duration of disinfection will be reduced to 15 minutes beginning in 2008.

Br. Year	Hood River Eggs Taken	Shock Loss
1997	N/A	N/A
1998	56,669	9.8%
1999	N/A	N/A
2000	N/A	N/A
2001	180,954	6.0%
2002	190,679	11.0%
2003	N/A	N/A
2004	83,929	50.9%
2005	159,574	23.3%
2006	124,387	29.9%
2007	135,000	28.4%

Future management goals at PFF hope to achieve a green-to-eyed egg survival rate of 90%. This does not account for any eggs culled because of BKD concerns.

9.1.2) Cause for, and disposition of surplus egg takes.

Extra spring Chinook salmon eggs are typically collected in order to compensate for egg-to-smolt mortality and culling associated with BKD positive parents. Surplus eggs, culled eggs, and surplus fish are placed in a dumpster.

9.1.3) Loading densities applied during incubation.

Green spring Chinook salmon eggs average size is approximately 80 to 90 eggs per ounce. The vertical stack egg incubators are adjusted for water flow of four gallons per minute. Each incubator tray typically receives approximately 3,000 spring Chinook salmon eggs or all of the eggs from one female.

9.1.4) Incubation conditions.

The water supply to the fish incubators is monitored for temperature, dissolved oxygen and flow. The eggs are incubated in water that is 39° to 42°F. Dissolved oxygen for the influent water ranges from 10 to 12 ppm. There is no data available on the DO for the effluent water.

Eggs from each female will be assigned an incubation tray traceable to the specific adult. Eight stacks with eight trays each are available. The eggs from up to two females can individually incubated per tray. The eggs from each spawning event will be incubated in separate stacks. The will allow of synchronous maturation. The use of submersible water heaters in some incubators will be necessary to synchronize emergence and fry development. Water flow, temperature and dissolved oxygen will be continually monitored.

9.1.5) Ponding.

Once the alevin completely absorb their yoke-sac (button up), after approximately 1,550 to 1,700 temperature units they will be ponded in Canadian starter troughs. At the time of ponding, the spring Chinook salmon fry size will be approximately 1,600 fish per pound. First ponding of fry is scheduled to begin at PFF in January, 2009.

9.1.6) Fish health maintenance and monitoring.

Incubating eggs are treated three times per week @ 1/600 ppm for 15 minutes with a formalin drip to prevent or control fungus and "soft shell". The incidence of yolk-sac malformation is typically less than 0.1 percent (i.e. < 1 per 1,000 eggs). Egg moralities are first removed with an automated egg picker. Any remaining egg mortalities are hand picked from groups of incubating eggs.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.

Eggs are incubated with spring water from Rogers Creek to reduce exposure to fish pathogens and silt. After completion of the HRPP Master Plan Revision, well water will be used for incubation.

9.2) <u>Rearing</u>:

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years , or for years dependable data are available.

It is impossible to present specific juvenile survival data, since the production groups of spring Chinook salmon are mixed for at least half the rearing cycle at Round Butte Fish Hatchery. However the fry-to-fingerling survival is typically greater than 90%. Fingerling to smolt survival is generally greater than 95%. The overall fry to smolt survival exceeds 85%. There has been considerable mixing of Hood River and Deschutes fish during rearing in the Pelton ladder cells. Some of the mixing can be associated with defective screens designed to separate the two production groups within the ladder cells.

9.2.2) Density and loading criteria (goals and actual levels).

Fingerlings complete rearing in the Pelton ladder cells from November through March. The pond loading goals are five pounds of fingerling per gallon per minute and eight pounds per gallon per minute for smolts. The pond density goals are two pounds of smolts per cubic foot of pond water, and one pound of fingerling per cubic foot of water. The ladder rearing cells density criteria is 0.45 pounds of pre-smolts per cubic foot of pond. The density criteria in the cells are 2.8 pounds of pre-smolts per gallon of water per minute.

Ponding densities at Moving Falls acclimation site will not exceeding IHOT recommendations. Dissolved oxygen of seven ppm will be sustained on the outflow with a Piper flow index of 1.68.

9.2.3) Fish rearing conditions

The PFF has constant and variable water temperatures from ground and surface water supplies. Rogers Creek water ranges from 39° to 42°F, while the Middle Fork Irrigation District delivers water ranging is temperature from 33° to 55°F seasonally. Two wells at PFF Facility will provide water at a constant 44.1°F. An oxygenation and nitrogen releasing tower will be incorporated into the well water supply. The Rogers Creek supply will be at saturation which is 12 ppm. Using the IHOT and Piper indexes, discharge water will be at 7 ppm or higher. Dissolved oxygen levels will only be monitored when loading densities are the greatest or if there is a concern for fish health. The Moving Falls acclimation ponds will have flow through water from the West Fork Hood River with temperatures ranging from 38° to 42°F during the late February through April.

At Parkdale Fish Facility an estimated 40,500 button up fry will be ponded in two Canadian Troughs (21'x 3'x3') beginning in January, 2009. Loading densities and water exchange rates will be based on recommendations by IHOT, Piper, and others. The Canadian troughs will be painted camouflage to incorporate some of the Natures rearing criteria. Rearing densities should not exceed a density index of 0.16 fish per cubic foot of water. Well water will be mixed with Rogers Creek water to maintain a constant temperature of not less than 42^0 F.
The fry will be fed to satiation with a goal to achieve a size of 250-300 fish per pound by 15 May. The spring Chinook will be fed a commercially manufactured fish pellet. At first ponding, the fry will be fed hourly or 8 - 9 times daily. An automated feed delivery system will be installed reducing human exposure. As the fry double their size, monthly feeding frequencies will be decreased.

Two key uncertainties that require evaluation are the survival rate and rate of feed conversion as the fry transition to active feeding at the available water temperature. Feed conversion will be closely monitored. Fry will be sampled on weekly basis to monitor food conversion by measuring weight and growth rates. Data will be collected using standard hatchery practices to record condition factor and fish per pound. Fish health monitoring will be conducted monthly unless unusually high mortality is observed. If the later is the case more frequent fish health surveys will be conducted.

The Canadian troughs will be inspected daily for mortality. Mortalities will be enumerated and cause of death identified. If cause of death cannot be determined on station the fish will be sent to a fish health laboratory for analysis. General fish health and behavior will be observed daily during feeding and mortality collection. Fish Health personnel will be contracted to conduct monthly examinations for parasites, bacterial and viral pathogens. Any unacceptable levels of mortality will prompt a call to ODFW for additional exams and treatment recommendations. Using a combination of vacuuming and brushes, the Canadian troughs will be cleaned at least weekly. The troughs will be cleaned routinely as needed either by vacuuming or brooming. A 300-J general National Pollution Discharge Elimination System (NPDES) permit will not be required due to the small production.

When fish reach 250-300 fish per pound they will be transferred to a divided 8' wide x 80' long raceway. Initially the raceway will be divided in half (8'X 40'). The pond depth will be increased to maximum depth of 3-4 ft. as the fish grow. Eventually the divider will be removed. There will be 1,280 cu. ft. available for final rearing. Fish densities will not exceed a density index of 0.16 lbs. per cu. ft. and a flow index of 1.73.

Waters sources will consist of a mixture of Rogers Cr. and MFID water from May through September. The goal will be to achieve the warmest water possible with turbid MFID water while maintaining sufficient visibility with clear Rogers Cr. water. During October through February final rearing only Rogers Cr. water will be used since it is the warmer of the two surface sources during this time period (refer to Table 3).

After the spring Chinook fry have reached approximately18 fish/lb, the production will be transferred to the Moving Falls acclimation ponds during late February or early March. First transfer is scheduled for 2010. A 500 gallon insulated fiberglass tank mounted on a ¾ ton pick-up will be used for transportation. Although still in the design stage, six ponds of approximately 10 ft X 60 ft each will accommodate approximately 150,000 smolts from PFF, Carson National Fish Hatchery and Pelton ladder. The rearing ponds will be painted camouflage and IHOT recommendations will be closely adhered to during final rearing. The six rearing ponds will receive gravity fed water from the West Fork Hood River. The water supply will be single pass usage. Incoming water will range from approximately 10-14 gpm. By keeping densities low, 7 gpm is achievable on the out flows. Fish loading will not exceed a density index of 0.16 in each pond.

While in the ponds site caretakers will perform daily scheduled fish culture duties that includes: checking the water intake and screens, recording oxygen, temperature and water levels in the rearing ponds three times each day, feeding the fish a maintenance diet and picking fish mortalities. Staff will observe fish behavior for abnormalities and assist in fish health checks, bi-weekly condition sampling and PIT tagging.

The goal will be to release all fish into the West Fork Hood River by the end of April. If a high water event occurs during April the fish will be forcibly released to coincide with the freshet. If no such event occurs the fish will be forced released at month's end.

9.2.4) Indicate biweekly or monthly fish growth information (*average program performance*), including length, weight, and condition factor data collected during rearing, if available.

When full term rearing begins at PFF length and weight data will be collected. Data will be included in monthly progress reports and hatchery evaluation studies. Currently condition factor estimates are made shortly before liberation. Weekly samples will be standard procedure during early rearing at PFF. During late-rearing and acclimation, bi-weekly samples will be collected.

9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available.

Once the fry have been ponded, their weight generally doubles each of the subsequent months for the first five months. Refer to the Round Butte Spring Chinook Salmon HGMP (ODFW, 2004) for juvenile growth data. Because fish have not been reared at PFF, there is no available growth data for this facility.

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Spring Chinook salmon juveniles reared at Round Butte Fish Hatchery are fed a dry fish diet at a rate and frequency that varies with fish size. For the first 90 days following ponding the fish are fed eight times per day. For the next 90 days they are fed four to six times per day. For the next two months they are fed three times per day. When the fish are transferred to the Pelton Ladder rearing cells the feeding rate and frequency varies as the result of an on-going feeding study. One cell is fed five days per week, four cells are fed two days per week and one cell is fed two days every 14 days. During the last six weeks, the juveniles in the ladder rearing cells are fed on demand two days per week prior to release.

Because of cool water temperatures at PFF, a moist pellet will be the preferred diet when fish rearing begins at this facility. Hourly feeding to satiation will be the early rearing feed regime. A 1.0 food conversion and doubling in size each of the first three month will be the goal. After initial growth data is collected beginning with BY 2008 a growth program will developed and used to achieve the desired size smolt going forward..

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

Fish health of rearing juvenile spring Chinook salmon is currently monitored monthly by ODFW fish health personnel. They identify disease problems and prescribe the appropriate treatments to eliminate or control the disease. Iodine antiseptic is routinely used to sanitize hatchery equipment and prevent the incidence or spread of fish disease. Similar procedures will occur when rearing begins at PFF and the Moving Falls rearing ponds.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.
The only index of smolt development data available is condition factor data collected prior to liberation. Beginning in 2010 with first smolt release from Moving Falls acclimation site intensive smolt development data will be collected as part of the program's efforts to reduce precocious sexual development. Study designs are included in Section 11 of this HGMP.

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.
Currently pre-smolt Chinook are reared for four months in the semi-natural rearing environment of the old Pelton Fish Ladder. There is abundant natural feed in the ladder, which is supplemented with commercial dry fish feed on a much reduced feeding schedule. The rearing densities are very low for pre-smolts in the ladder cells.

Fish transported to acclimation facilities in the Hood River subbasin experience natural-colored pond walls and/or in-water structures to simulate natural rearing conditions. Human contact is generally minimized during the ladder rearing and acclimation. PFF's camouflaged acclimation ponds receive approximately 18 discarded Christmas trees for cover. Efforts will be made to simulate natural rearing conditions at PFF and the Moving Falls acclimation site when full in-basin production begins.

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.
HRPP spring Chinook salmon are not listed under the ESA. However, fish are reared to sub-yearling smolt size to mimic the natural fish emigration strategy and to minimize the risk of domestication effects that may be imparted through rearing to yearling size. Fish are reared for a minimum of four months in the semi-natural conditions of the old Pelton Fish Ladder and human contact is minimized. Discarded Christmas trees are place in PFF's camouflaged acclimation ponds to provide additional cover. Simulated natural rearing conditions will be used where practicable for any additional rearing either at PFF or the Moving Falls acclimation facility.

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs				
Unfed Fry				
Fry				
Fingerling				
Yearling	125,000 current program through 2009. 150,000 Revised Program , 2010	**12/lb – Current** 15-18/lb – Revised Program	**April-early May (Volitional)** Late April (Forced)	**Current**: 30,000 in Middle Fork; 95,000 in West Fork **Revised Program**: 150,000 in West Fork

10.2) Specific location(s) of proposed release(s)

Stream, river, or watercourse:

	West Fork Hood River:	HUC: 1707010503
	Middle Fork Hood River:	HUC: 1707010502 (through 2009)
Release point:	Middle Fork Hood River:	RM 19.0 (through 2009)
	West Fork Hood River:	RM 21.0 and 26.5 (through 2009)
	West Fork Hood River:	RM 2.5 (start 2010)
Major watershed:	Hood River	
Basin or Region:	Columbia	

10.3) Actual numbers and sizes of fish released by age class through the program.

Release year	Eggs/ Un-fed Fry	Avg size	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
1996							129,211	9.8
1997							101,093	8.2
1998							124,783	9.8
1999							121,419	7.0
2000							102,765	5.7
2001							120,901	9.5
2002							101,009	14
2003							126,353	12.7
2004							128,256	13.5
2005							112,968	11.9
2006							113,779	12.1
2007							127,829	9.7
Average							117,531	10.3

10.4) Actual dates of release and description of release protocols.

Spring Chinook smolts are transported to Hood River acclimation ponds beginning in early April. The volitional release of Chinook smolts is generally complete by early May. Release of spring Chinook smolts from acclimation ponds is based on the following criteria: 1) smolt readiness in terms of appearance, crowding outlet, etc., and 2) release time that corresponds to natural smolt out migrants. Smolts are volitionally released for about two weeks. Non-migrants are trucked and released at the mouth of the Hood River.

HRPP spring Chinook salmon volitional smolt releases 2002-2007.

Drainage, Release Location, Release year, Release group,	Date transferred to raceways	Number transferred to raceways	Fish/lb at transfer	Number of days acclimated	Mortalities in acclimation raceway	Number volitionally released	Number liberated to Columbia	Total released
West Fork,								
Blackberry Creek,								
2002,								
Group 1	28-Mar	23,520	14.7	8	92	18,579		
Group 2	16-Apr	25,632	14.4	9	565	20,218	9,698	48,495
2003,								
Group 1	1-Apr	27,474	11.4	6	139	25,322		

Drainage, Release Location, Release year, Release group,	Date transferred to raceways	Number transferred to raceways	Fish/lb at transfer	Number of days acclimated	Mortalities in acclimation raceway	Number volitionally released	Number liberated to Columbia	Total released
Group 2	15-Apr	28,504	11.2	7	212	26,278	4,027	55,627
2004,								
Group 1	29-Mar	29,112	13.2	8	96	28,991		
Group 2	17-Apr	28,215	13.5	7	334	27,855	51	56,897
2005,								
Group 1	17-Mar	24,480	13.6	0	0	0	0	24,460
Group 2	7-Apr	18,788	12.2	8	10	18,664	91	18,755
2006,								
Group 1	4-Apr	30,635	12.8	13				
Group 2	18-Apr	34,809	11	20	86	63,622	1,822	65,444
2007,								
Group 1	3-Apr	29,016	11.7	7	100			
Group 2	17-Apr	26,864	10.4	7	145	52,666	2,904	55,570
Jones Creek,								
2002,								
Group 1	28-Mar	16,170	14.7	8	2,080	14,090	0	14,090
2003,								
Group 1	29-Mar	20,235	11.4	6	67	15,650		
Group 2	17-Apr	19,996	11.4	7	91	15,386	9,037	40,073
2004,								
Group 1	29-Mar	19,575	13.2	8	6	18,496		
Group 2	17-Apr	19,696	13.5	7	38	18,585	2,146	39,227
2005,								
Group 1	17-Mar	20,060	13.6	10	70	19,975	0	19,975
Group 2	7-Apr	20,130	12.2	8	43	20,007	65	20,072
2006,								
Group 1	4-Apr	19,259	12.8	13		18,907		
Group 2	18-Apr	24,905	11	20	90	22,731	2,526	41,638
2007,								
Group 1	3-Apr	20,684	11.7	7	143			
Group 2	17-Apr	20,384	10.4	7	246	39,123	1,455	40,578
Middle Fork,								
Parkdale Fish Facility,								
2002,								
Group 3	Mar 5-6	31,293	13.2	29-30	50	30,941	302	31,243
2003,								
Group 3	3-Mar	30,720	12.9	33	67	30,638	15	30,653
2004,								
Group 3	Mar 1-2	32,180	13.4	31-32	48	31,932	200	32,132
2005,								
Group 3	1-Mar	29,796	13.7	31	76	29,669	37	29,706
2006,								
Group 3	6-Mar	33,160	12	15	207	32,933	0	32,933
2007,								
Group 1	6-Mar	31,784	13.7	14	91	31,681	0	31,681

Beginning during 2010 all smolts will be forced released from the Moving Falls acclimation facility into the West Fork Hood River during late-April. Water levels will be gradually lowered in the ponds and fish will exit via the outlet pipe directly into the West Fork.

10.5) Fish transportation procedures, if applicable.

Spring Chinook are transported from the Pelton Ladder to acclimation ponds in the Hood River subbasin. A 1,600 gallon liberation truck, loaded at 1.25 lbs of fish/gal is used to transport the fish. Fish are in transit about three hours. Temperatures are regulated to the same temperatures as the receiving water. Transport trucks are equipped with two redundant oxygen systems.

Fish will be transferred from PFF to the Moving Falls acclimation facility using a 500 gallon insulated fiberglass tank mounted on a ¾ ton pick-up will be used for transportation. The water will be circulated and oxygenated during the 35 minute transit.

10.6) Acclimation procedures.

Spring Chinook salmon are acclimated and released from three sites in the Hood River subbasin. Two sites are located in the West Fork and one site at the Parkdale Fish Facility on the Middle Fork. These sites were chosen because of their close proximity to prime spawning and rearing habitat. The West Fork sites are at Blackberry Creek (RM 21.0) and Jones Creek (RM 26.5). The ModuTank portable ponds measure 11’9”x49’3”x4’9” and have a capacity of 19,500 gallons. These polypropylene-lined steel ponds are equipped with standpipes for water level regulation.

At Blackberry Creek, two acclimation ponds are supplied with about 400 gpm water from the nearby creek. This tributary has an impassible falls at its mouth. The strategy is to allow spring Chinook to home back to the West Fork in this area but not allow them to enter Blackberry Creek. The Jones Creek acclimation site has a single pond. The water supply is from Jones Creek, a small tributary of the West Fork that is intermittent during the summer. Parkdale Fish Facility acclimates spring Chinook smolts in one of its 8x80 foot concrete camouflage painted ponds.

Spring Chinook are normally brought to the acclimation ponds during the first week of April. Fish are held at the site for about 6-9 days before they are allowed to move out of the ponds on their own volition. Volitional release lasts about one week. All acclimation ponds, including the Parkdale Fish Facility, have habitat structures to provide cover for fish. At the beginning of release, the vertical standpipe that regulates the pond level is gradually lowered over a period of several days. The first lowering is to about three feet of pond depth, then finally to two foot after about five days. The standpipe is fitted with a hopper to allow fish to easily find the outlet. The process of holding fish, acclimating, and releasing them is repeated if a second group of fish is brought from Pelton Ladder to the ponds. All remaining fish that do not move out of the ponds during the first release are held with the second group and given a second chance to move out volitionally. At the end of the volitional release period all non-migrants are collected, transported, and released at the mouth of the Hood River.

At Parkdale Fish Facility, fish are released following the same schedule and procedure followed at the portable pond sites. However, instead of a standpipe to regulate the pond level, stoplogs are used.

After the spring Chinook fry have reached approximately 18 fish/lb, the production will be transferred to the Moving Falls acclimation ponds during late February or early March. First transfer is scheduled for 2010. A 500 gallon insulated fiberglass tank mounted on a ¾ ton pick-up will be used for transportation. Although still in the design stage, six ponds of approximately 10 ft X 60 ft each will accommodate approximately 150,000 smolts from PFF, Carson National Fish Hatchery and Pelton ladder. The rearing ponds will be painted camouflage and IHOT recommendations will be closely adhered to during final rearing. The six rearing ponds will receive gravity fed water from the West Fork Hood River. The water supply will be single pass usage. Incoming water will range from approximately 10-14 gpm. By keeping densities low, 7 gpm is achievable on the out flows. Fish loading will not exceed a density index of 0.16 in each pond.

While in the ponds site caretakers will perform daily scheduled fish culture duties that includes: checking the water intake and screens, recording oxygen, temperature and water levels in the rearing ponds three times each day, feeding the fish a maintenance diet and picking fish mortalities. Staff will observe fish behavior for abnormalities and assist in fish health checks, bi-weekly condition sampling and PIT tagging.

The goal will be to release all fish into the West Fork Hood River by the end of April. If a high water event occurs during April the fish will be forcibly released to coincide with the freshet. If no such event occurs the fish will be forced released at month's end.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

All program spring Chinook salmon are adipose fin clipped and coded wire tagged (CWT'ed). Differential fin clips alternating between Ad/LM and Ad/RM are used to differentiate fish reared in Pelton Ladder and released in the West Fork from those reared in Round Butte hatchery raceways. From BY 2007-2009 all fish are reared in Pelton ladder. Alternating secondary clips will used among release years.

Under the revised Master Plan all fish will be ad-clipped and CWT'ed. A secondary fin clip will be used to identify fish reared in each facility (PFF, Carson Hatchery and Pelton Ladder). Additionally 10% of each group will be PIT tagged.

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

All releases are within programmed and approved levels.

10.9) Fish health certification procedures applied pre-release.

Fish are certified by ODFW pathologists prior to release.

10.10) Emergency release procedures in response to flooding or water system failure.

All ponds are equipped with water level and flow alarms and standby water aerating / re-circulating pumps. In the event of an un-repairable water system failure or flood, fish would be forced from the pond.

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

Interaction of hatchery spring Chinook and listed summer steelhead juveniles should be minimized using the acclimation release strategy for full term smolts. Screw trap and PIT tag information has shown the hatchery spring Chinook smolts move very quickly out of the subbasin.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

The M&E component of the HRPP provides the quantitative data needed by fishery managers to 1) determine if the biological fish objectives for the HRPP have been achieved, or are achievable, 2) optimize the benefits associated with the HRPP, and 3) minimize the HRPP's effect on ESA listed species (and other indigenous populations of fish) in the Hood River subbasin. The following describes types of monitoring applicable to the spring Chinook salmon production component of the HRPP. Please refer to the revised HRPP Master Plan for a more complete description of the program.

11.1) Monitoring and evaluation of "Performance Indicators" presented in Section 1.10.

11.1.1) Describe plans and methods proposed to collect data necessary to respond to each "Performance Indicator" identified for the program.

Spawning Escapement and Distribution

Objective: Determine escapement of natural origin returns (NORS) and hatchery origin returns (HORs) to the West Fork Hood River.

***Metric**:* Fish enumeration at Moving Falls trap and redd counts.

Purpose: Enumeration of returning adults to the Moving Falls trap will allow managers to determine numbers of naturally produced adults escaping to the spawning grounds, hatchery returns and out of basin strays. Sex, age and disposition data will be collected. The weir counts, along with basin-wide redd counts upstream of the weir; will allow investigators to determine the progress of the natural population in sustaining and rebuilding itself. HOR will be evaluated to determine whether broodstock collection goals are met. Total West Fork escapement (above and below the weir) will be estimated from trap and redd counts.

Null Hypothesis: Natural spawner escapement and hatchery broodstock goals are not being achieved.
Alternative Hypothesis: Spawner escapement and hatchery broodstock goals are being achieved.

Timeline: Results will be evaluated annually to develop future run size predictions and compared to predictions. After year five (on generation) of full program implementation, NOR escapements will be evaluated, in conjunction with other data, to determine if the NOR are rebuilding the population without the need for re-commencement of supplementation.

Method: HOR and NOR spring Chinook salmon will be collected in an adult trapping facility located at RM 2.5 in the West Fork Hood River. The trap will be operated 24 hours a day and will be sampled once each day during the April through October migration season. All species of fish trapped will be identified and counted. Each spring Chinook salmon will be sampled for scales and length, sexed and examined for fin marks and external tags. After sampling, the fish will either be passed upstream (NOR) or collected for brood (HOR and NOR).

To account for escapement in the West Fork downstream of Moving Falls, redd counts will be conducted in the 2.5 mile reach. A fish per redd ratio for redds upstream of the weir will be applied to the total number of redds counted below the weir. The number of HOR and NOR enumerated at the weir will be added to the redd count expansion for spawners below the weir. The sum will then be used to estimate returns of HOR and NOR to the West Fork Hood River.

Smolt to Adult Survival
Objective: Measure smolt to adult survival for hatchery and natural origin spring Chinook salmon in the West Fork Hood River.

Metric: Smolt to adult survival will be calculated as follows:

$$S_{\text{smolt-adult}} = \text{Adults and Jacks}_{\text{ brood year x}} / \text{Smolts}_{\text{ brood year}}$$

Purpose: For hatchery adults, the smolt to adult ratio (SAR) will be used to evaluate the premise that SARs will increase with the change to in-basin production and incorporation of NOB. This will be a critical parameter to evaluate success of different release numbers and strategies (such as time of and size at release) that will likely be tested during adaptive management designed to incorporate natural smolts.

For natural production, SARs will be compared other naturally produced stocks to determine if they are similar. If comparisons among basins are dissimilar it may indicate some post smolt factor may be limiting natural production.

Hatchery Origin Null Hypothesis: SARs will not significantly improve from pre-project levels.
Hatchery Origin Alternative *Hypothesis:* SARs will increase when all production occurs in-basin.
Natural Origin Null Hypothesis: Hood River natural origin SARs will be lower that those from other basins per brood year.
Natural Origin Alternative *Hypothesis:* Hood River natural origin SARs will be similar to other basins per brood year.

Timeline: SARs will be calculated for each brood year return. Therefore, data will not become available until 5 years following the implementation of in-basin rearing and Moving Falls weir installation.

Methods: Each hatchery-produced spring Chinook salmon will be marked with an adipose fin clip and coded wire tag (CWT). CWTs will be used to calculate SARs from each release group. Pre-release CWT retentions will be used to estimate the number of fish with CWTs released. All returning jacks and adults captured at the Moving Falls weir will be inspected for marks and scanned for the presence of a CWT. To verify origin scale samples will be collected from all marked fish that do not contain CWTs. All NOR that have an adipose fin and no CWT detection that are not used for broodstock will be measured as described above and passed upstream. Smolt estimates for hatchery fish will be determined from the number of tagged smolts released. Naturally produced smolt emigration estimates will be generated from the Moving Falls rotary screw trap.

Predict Pre-Season Hatchery and Natural Fish Escapement.
Objective: Annual pre-season escapement forecasts for hatchery and natural fish in the West Fork Hood River.

Metric: A relationship where age-specific adult return size is significantly correlated with out-migrating smolts, returning jacks, and siblings to make pre-season forecasts. The sum of forecasts of all age-specific return sizes will equal total run size forecasted to return. Development of a run-size predictor will be an ongoing process, in which the predictive function will be upgraded each year with the new information available.

Purpose: Managers need to know in advance run size and timing to achieve an adequate escapement of natural fish and broodstock collection in addition to maximizing tribal and sport harvest of opportunities. With broodstock collection occurring upstream of the fisheries developing accurate estimates with known precision will be essential to establishing fishery seasons and harvest limits if necessary.

Timeline: Ongoing.

Methods: Initial run predictions will be made using smolt out-migrant numbers from the previous year, redd counts from three years before, adult return numbers by age from the previous year and mean brood year age at return. Natural jack estimates will be based on Moving Falls trap counts from three years prior. Hatchery jack estimates are based on the number of smolts released the previous year, as well as the average return rate. An estimate of age 4 and age 5 returns from previous year returns of age 3 and age 4 fish and mean conversion rates will be developed from mean brood year age at return. Mean conversion rates will be recalculated every year using all available data. To determine the success of this predictor, run size projections will be compared with actual returns to the Moving Falls weir. For broodstock management, methods to determine in-season harvest adjustments will be investigated using returns of PIT tagged adults past Bonneville dam by age class.

Determine Annual Tribal and Sport Catch, Harvest, and Effort for Hatchery Spring Chinook Salmon in the Hood River Subbasin.
Objective: Annual estimate of in-river harvest.

Metric: Enumerate tribal and sport fisheries by gear type, numbers of fish caught and kept, numbers released, catch per unit effort (CPUE), and other relevant catch information.

Purpose: To determine exploitation rates and provide information to regulate harvest seasons to ensure adequate broodstock collection and hatchery escapement if further supplementation is necessary. Harvest opportunities are likely to increase as tribal interest increases and sport fishers have renewed access to additional fishing grounds. Estimates of harvest in conjunction with run size predictions will be used to determine if exploitation rates limit the project's ability to collect broodstock.

Timeline: Ongoing.

Methods: River-wide surveys will be conducted any time that fishing seasons for spring Chinook salmon are permitted. Methods, as described in Olsen (2007), will include roving creel surveys (pressure counts and interview) and census counts. Biological data and fish origin based on the presence/absence of adipose fin, CWT / PIT tags, or other mark types will also be collected. Exploitation rates will be estimated as subbasin harvest divided by escapement to Moving Falls weir plus estimated harvest.

To estimate tribal harvest at Punchbowl Falls, monitoring surveys will be of a stratified random design to determine weekday versus weekend fishing preference. Information to be collected in the fishery will include the following: 1) number of fishers, 2) time period engaged in fishing activity, 3) fisher catch per hour (FCPH) for fisher monitoring or harvest per unit effort (HPUE) for fisher interviews, 4) species, 5) number of natural Chinook salmon released, and 5) number of hatchery Chinook salmon harvested. This information will collected in conjunction with other biological data described in the river-wide harvest surveys.

Determine Ocean and Mainstem Harvest Rates
Objective: Estimate ocean and mainstem Columbia River harvest rates of Hood River spring Chinook salmon to determine if out of basin harvest rates are likely to limit project success.

Metric: 100% marking of Hood River hatchery spring Chinook salmon. Statistically valid surveys along the Pacific Coast (Alaska, British Columbia, Washington, Oregon, and California) and Columbia River to estimate total harvest by commercial, tribal, and recreational fisheries. Ocean and mainstem recoveries of CWTs are reported to the Pacific States Marine Fisheries Commission. We will retrieve data on actual and expanded CWT recoveries in the ocean and mainstem from the Regional Mark Information System (RMIS).

Purpose: Determine percentage of hatchery population harvested in the ocean and Columbia River. Combined with in-river harvest total harvest estimates by brood year will be calculated. Ocean, mainstem and in-river harvest estimates will allow managers to quantify harvest occurring over the entire life cycle in commercial, sport and tribal fisheries. Information will be provided to Pacific Salmon Commission for ocean harvest regulation and Columbia River Compact for mainstem harvest management.

Timeline: Ongoing.

Methods: Coded wire tags and an adipose clip will be applied to all hatchery spring Chinook salmon released from the Hood River. We will query data that are summarized and expanded in the RMIS database maintained by the PSMFC.

Fish Health Monitoring Plan:
Currently ODFW Fish Health Services is contracted to provide services to prevent, detect, and treat, when possible, fish diseases in both juvenile and adult fish for the Hood River anadromous fish program operated at Parkdale Fish Facility.

Adult spring Chinook salmon, and summer and winter run steelhead trout are captured and held at the Parkdale Facility until ready to spawn. These fish may be held for several months prior to reaching maturity and spawning. This requires attention to maintain healthy broodstock. Adults are treated with antibiotics and anti-fungal treatments during this holding period prior to spawning as directed with veterinary prescriptions written and obtained from ODFW Fish Health Services. If abnormal losses occur in these adult fish, a fish health specialist will examine the loss as soon as possible. The Fish Health Specialist will determine the cause of loss, if possible, and recommend treatments to prevent further loss. The Parkdale Fish Facility manager and the ODFW fish health supervisor will be informed of the results as soon as possible.

When adults reach maturity and are spawned, a fish health specialist will be on site and obtain samples from each adult fish. Spring Chinook salmon are spawned from August through September and steelhead trout from March through May. Each spring Chinook salmon is sampled at spawning to determine if the fish was infected with *Renibacterium salmoninarum*, the causative agent of bacterial kidney disease (BKD). Samples are also taken to determine if the fish is infected with viruses. Tests will be able to detect at least four specific fish viruses. The samples are analyzed at ODFW laboratories. The tests are preformed by ODFW Fish Health personnel. Results are reported to the manager of the Parkdale Fish Facility. A relational database of adult fish examinations and results is maintained.

While the juvenile spring Chinook salmon are reared at Round Butte Fish Hatchery and Pelton ladder they receive monthly on-site examinations from an ODFW Fish Health Specialist. At least six healthy active fish are examined for internal and external parasites and pathogens. Any dead fish are examined externally and internally for signs of disease. The kidney (or other appropriate organ) is cultured to detect bacterial pathogens. The Fish Health Specialist will recommend treatments based on the examination to prevent abnormal loss of fish to disease. If abnormal losses occur in these fish, a fish health specialist will respond and examine the loss as soon as possible. The Fish Health Specialist will determine the cause of loss, if possible, and recommend treatments to prevent further loss. Prior to delivery to the Hood River acclimation sites a pre-liberation examination is conduct within six weeks of delivery. Also a sixty fish sample of pre-release healthy fish are obtained to determine the infection rate, if any, with *Renibacterium salmoninarum*, the causative agent of bacterial kidney disease (BKD).

Fish health monitoring will remain as described above when full term spring Chinook production begins with the BY 2008. However pre-release sampling will occur at the Moving Falls acclimation facility. Immediately prior to forced release approximately 100 fish will be sacrificed for a precosity study as part of the hatchery evaluation study described below. After examination the carcasses will be sent to the USFWS Lower Columbia Fish Health Laboratory to be examined for the presence of BKD. Enzyme-linked immunosorbent assay (ELISA) will be used to measure the level and severity of BKD in fish at the time of release and at return. Levels of BKD would be correlated to the facility rearing treatment, gonadal development (precosity) and the numbers of returning mini-jacks (one year old fish) and jacks (two year old fish).

Spring Chinook Salmon Hatchery Evaluation

- As part of the revised master plan we are proposing a comparative hatchery release evaluation that compares the size at release, precocial maturation and smolt through adult survival (SARs) of spring Chinook released in the Hood River basin that are reared at Carson National Fish Hatchery in the Wind River drainage (WA), Round Butte Hatchery / Pelton Ladder in the Deschutes basin (OR) and a test group of juveniles reared at the Parkdale Fish Facility (PFF) in the Hood River basin. The results will provide the necessary information for co-managers to determine a long term biologically sound and cost effective spring Chinook salmon production strategy for the Hood River basin that balances harvest needs with ecological considerations. Refer to the revised HRPP master plan M&E section for a complete study design.

- The goal of this evaluation is to provide managers with the information necessary to determine the most cost effective approach (or combination of approaches) for: 1) rearing HRPP spring Chinook salmon smolt to an average size of 15-18 fish per pound at release; and 2) increasing the average adult SAR to 0.6% while maintaining a minimum SAR above 0.35%.

Hypothesis 1: There are no significant differences in smolt size between groups of fish reared in Pelton Ladder, Carson Hatchery and PFF that are released in the West Fork Hood River.
Alternative1: There is a significant difference in smolt size between groups of fish reared in Pelton Ladder and Carson Hatchery and PFF that are released in the West Fork Hood River.

Hypothesis 2: Rate of precocial maturation are similar among Carson Hatchery, Pelton Ladder and PFF release groups that are released in the West Fork Hood River.
Alternative 2: Rate of precocial maturation are not similar among Carson Hatchery, Pelton Ladder and PFF release groups that are released in the West Fork Hood River.

Hypothesis 3: There is no significant difference in SARs from smolts released at Moving falls to adult returns to the Moving fall weir among groups of fish reared in Pelton Ladder, Carson Hatchery and PFF.
Alternative 3: There are significant differences in SARs from smolts released at Moving falls to adult returns to the Moving fall weir among groups of fish reared in Pelton Ladder, Carson Hatchery and PFF that are released in the West Fork Hood River.

The performance metrics we will measure include: 1) size at release; 2) proportions of age 3 jacks and yearling mini-jack returns; and 3) smolt to adult survival (SAR) for release groups.

Smolt Size at Release:
Our goal will be to estimate the mean length from each release group of spring Chinook salmon from the 2008 brood that are within ±2 mm of the true mean, 95% of the time.

Additionally specific growth rates and condition factor will be determined monthly at each rearing facility and bi-weekly during acclimation. Both batch weights (fish per pound) and individual lengths and weights from sixty fish per release group will be recorded monthly.

The proportion of each release group that returns as yearling mini-jacks will be determined by pre-release visual examination. Each release group will be sampled for elevated plasma levels of hormone 11 Ketotestosterone (11-KT) and the presence of Bacterial Kidney Disease (BKD). Age 3 jack returns will be determined through CWT recaptures.

The numbers of precociously maturing males will be divided by the total number sampled to estimate the proportion of precocious maturation for each release group. This proportion will be multiplied by the number of smolts in each release group to estimate the percentage of smolts that are mini-jacks. The SAR for the brood year return will be applied to the estimated number of precocious smolts to estimate the number of mini-jacks by release group.

Smolt to Adult Survival:
Tagged adults from the 2010 release (2008 brood year) will be recaptured in ocean fisheries; Columbia River fisheries; Hood River fisheries; during carcass surveys below the Moving Falls weir; and at the Moving Falls weir during 2011-2014. All adults returning to the Hood River will be sampled for fin-marks and the presence of CWTs and PIT tags when encountered (harvest monitoring, carcass surveys and the M.F. weir). The coast-wide and Columbia River CWT monitoring program will randomly sample commercial and recreational fisheries for CWT presence. These sampling programs examine a subset of the total catch. The observed CWTs are expanded for the proportion sampled to estimate the total number of CWT fish that are harvested in each fishery. Refer to the Pacific States Marine Fisheries Commission's Regional Mark Processing Center for methods used to expand tag recovery at PSMFC.org.

Accounting for fishery exploitation in Columbia River Zone 6 tribal fisheries using CWT recoveries will be difficult due incomplete sampling effort. To estimate harvest between Bonneville dam and the mouth of the Hood River we will determine the proportion of PIT tag recaptures of returning adults at Bonneville dam and subtract them from subsequent recaptures in the Hood River.

- The study will begin with the collection of eggs from the 2008 brood year. Eggs would be collected from the 2008-2013 broods to be raised at each facility. The final release would occur during 2015. Results would be evaluated after the return of age V adults from the 2008 brood in 2013. The table below displays the tentative timeline.

11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.
The M&E component of the HRPP is entirely funded by Bonneville Power Administration under project number 1988-053-03 to the Confederated Tribes of the Warm Springs Reservation of Oregon and project numbers 1988-053-04 and 1993-019-00 to the Oregon Department of Fish and Wildlife. Current monitoring and evaluation funding covers most of the activities described above. Pending successful completion of the NWPPC Three Step Review process BPA should provide sufficient funds to implement the Spring Chinook Hatchery Evaluation Study.

11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.
Juvenile Trapping: Migrant traps are checked daily during periods of operation, fitted with a large holding box to minimize crowding and operated according NOAA Fisheries guidelines.

Adult Trapping: The adult trap at Powerdale am is operated five to seven days per week. The trapping facility was designed in a manner that minimizes stress related mortality associated with the handling of fish for counting and bio-sampling. Anadromous salmonids can quickly be sampled and transported to selected locations via a network of tubes located in the sampling area. The tubes are designed to efficiently and safely move fish to either 1) a recovery pond above Powerdale Dam that has an outlet to the mainstem of the Hood River, 2) holding pens located at the Powerdale Dam Fish Trap, or 3) a liberation truck that is used transport broodstock to the HRPP's Parkdale facility.

Operation of the trap at Moving Falls will be similar to that described above except the trap will be operated daily during the period of operation. After bio-sampling fish will either be immediately passed upstream or transferred to a liberation truck for transfer to the Parkdale Fish Facility.

Redd Surveys: Experienced surveyors conduct spawning ground surveys. Surveyors walk along the stream counting redds, live fish, and inspecting carcasses. Precautions are taken to avoid redds and live adults.

SECTION 12. RESEARCH
There is no planned research associated with this HGMP and listed fish.

12.1) Objective or purpose.
12.2) Cooperating and funding agencies.
12.3) Principle investigator or project supervisor and staff.
12.4) Status of stock, particularly the group affected by project, if different than the stock(s) described in Section 2.
12.5) Techniques: include capture methods, drugs, samples collected, tags applied.
12.6) Dates or time period in which research activity occurs.
12.7) Care and maintenance of live fish or eggs, holding duration, transport methods.
12.8) Expected type and effects of take and potential for injury or mortality.
12.9) Level of take of listed fish: number or range of fish handled, injured, or killed by sex, age, or size, if not already indicated in Section 2 and the attached "take table" (Table 1).
12.10) Alternative methods to achieve project objectives.
12.11) List species similar or related to the threatened species; provide number and causes of mortality related to this research project.
12.12) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed fish as a result of the proposed research activities.

SECTION 13. ATTACHMENTS AND CITATIONS

BPA (Bonneville Power Administration). 1996. Hood River fisheries project. Final environmental impact statement (DOE/EIS-0241). Bonneville Power Administration, Portland, Oregon.

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CRITFC (Columbia River Inter-Tribal Fish Comission). 1996. Wy-Kan-Ush-Mi-Wa-Kish-Wit. Spirit of the Salmon. The Columbia River anadromous fish restoration plan of the Nez Perce, Umatilla, Warm Springs and Yakima tribes. Portland, Oregon; Volumes I & II.

McCanna, J., G. Wyatt and R. Gerstenberger. 2007. Hood River Monitoring and Evaluation. Annual Report 2006 of the Confederated Tribes of the Warm Springs Reservation, Oregon (Project Number 1988-053-03, Contract 29952) to Bonneville Power Administration, Portland, Oregon. http://www.efw.bpa.gov/Publications/P103385.pdf

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Smith, M. and CTWSRO. 1991. Pelton ladder master plan. Final Report of the Oregon Department of Fish and Wildlife and the Confederated Tribes of the Warm Springs Reservation, Oregon. (Project 89-029, Contract DE-BI79-89BP01930) to Bonneville Power Administration. Portland, Oregon. http://www.efw.bpa.gov/publications/U01930-1.pdf

Underwood, Dk.D., C.G. Chapman, N.K. Ackerman, K.L. Witty, S.P. Cramer and M.L. Hughes. 2003. Hood River production program review 1991-2001. Final report of S.P. Cramer and Associates, Inc. (Project Number 1988-053-14; Contract Number 00010153-1) to Bonneville Power Administration, Portland, Oregon. http://www.efw.bpa.gov/Publications/A00010153-1.pdf

SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the information provided is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973."

Name, Title, and Signature of Applicant:

Certified by_____________________________ Date:_____________

ADDENDUM A. PROGRAM EFFECTS ON OTHER (AQUATIC OR TERRESTRIAL) ESA-LISTED POPULATIONS. (Anadromous salmonid effects are addressed in Section 2)

15.1) List all ESA permits or authorizations for USFWS ESA-listed, proposed, and candidate salmonid and non-salmonid species associated with the hatchery program.

Activities associated with the existing HRPP have been authorized by ESA Section 10 Permits (#899).

The Hood River Production Program is a Bonneville Power Administration funded program and is included in the NMFS Section 7 consultation biological opinion entitled: "Biological Opinion on Artificial Propagation in the Columbia River Basin – Incidental take of listed salmon and steelhead from federal and non-federal hatchery programs that collect, rear and release unlisted fish species" (March 3, 1999).

15.2) Describe USFWS ESA-listed, proposed, and candidate salmonid and non-salmonid species and habitat that may be affected by hatchery program.

Bull trout (*Salvelinus confluentus)* in the Hood River Subbasin are part of the Columbia River Distinct Population Segment (DPS), which was listed as federally threatened in 1998. The following information is from the Hood River Subbasin Plan (Coccoli ed, 2004):

Bull Trout Abundance: A comprehensive population assessment is not available, but at present the total number of adult bull trout in the recovery unit is believed to be less than 300 (USFWS, 2003). A population size of at least 500 adults is recommended in order for the population to be considered recovered (USFWS, 2003). Snorkel surveys conducted in Clear Branch above Clear Branch Dam found annual high counts of 51 to 200 adult and juvenile bull trout between 1996 and 2003. Surveys below Clear Branch Dam found annual high counts of 0 to 3 bull trout. Migratory bull trout have been counted at the Powerdale Dam fish trap continuously since 1992, with numbers trapped ranging from a high of 28 fish in 1999 to 2 fish in 1993. Counts were made from 1963-1971, but these are considered incomplete because they were either not continuous or made in only one of two dam fish ladders operated at the time.

Bull Trout Life History Diversity: Bull trout in the Hood River subbasin remain in freshwater throughout their life history and are believed to exhibit 3 life history patterns.

Resident and migratory life history forms are found above and below the Clear Branch Dam. A fluvial population migrates between tributaries used for spawning and early rearing, using larger streams such as the Hood River mainstem and the Columbia River for late juvenile or adult rearing. An adfluvial population spawns and rears in upper Clear Branch and Pinnacle Creek and uses Laurance Lake for rearing. Resident bull trout generally confine their migrations within their natal stream (Buchanan et al. 1997). Scale analysis indicates that of bull trout captured at Powerdale Dam are 3 to 8 years old.

Bull Trout Population Trend: The current population trend is unclear from the available data. Both the annual snorkel survey data from 1996 -2006 and the Powerdale Dam adult trap counts from 1992-2006 show moderate to high variation from year to year. The number of adults captured at Powerdale Dam Fish Trap from 1992-2006 ranged from 2-28

Bull Trout Unique Population Units: Two Local Populations of bull trout were identified in the draft US Fish and Wildlife Service Bull Trout Recovery Plan, one in Clear Branch and one in the Hood River. The two local populations are separated by the Clear Branch Dam, which has blocked the upstream migration of bull trout since its construction in 1969.

Bull trout in the subbasin are also threatened by isolation and habitat fragmentation from passage barriers including dams, impaired water quality, and habitat impacts from past and ongoing forest management and water diversion for irrigation (U.S. Fish and Wildlife Service, 1998).

15.3) <u>Analyze effects.</u>

The effects of the HRPP's spring Chinook salmon program on bull trout populations in the Hood River is unknown but is believed to be small. Adult bull trout are captured and handled at Powerdale Dam Fish Trap during spring Chinook brood collection. Additionally a few juvenile bull trout are sampled at rotary screw traps during the course of smolt out-migration monitoring. Handling methods are described in Olsen, 2007. The Hood River is closed to bull trout harvest. Some bull trout are incidentally hooked by sport fisherman but the numbers are believed to be low (Olsen, pers. comm.). Bull trout have never been recorded in the tribal harvest in the West Fork at Punchbowl Falls. The numbers of bull trout handled annually by the HRPP is displayed below.

Numbers of adult bull trout captured annually at Powerdale Dam Fish Trap and juvenile captured in mainstem Hood River and Middle Fork Hood River screw traps 1992-2007.

	Adults (Powerdale Trap)	Juveniles (Mainstem)	Juveniles (Middle Fork)
1992	6	-	-
1993	2	-	-
1994	11	1	-
1995	11	0	-
1996	18	0	6
1997	6	0	11
1998	18	3	22
1999	28	0	1
2000	27	0	1
2001	12	0	1
2002	5	2	11
2003	4	0	0
2004	10	0	0
2005	7	0	6
2006	4	0	1
2007	6	0	0

Operation and maintenance of Parkdale Fish Facility likely has no effect on bull trout. Bull trout have not been identified in Rogers Cr., one of the facility' water sources. The intake is screened to NOAA standards. The other water sources (Middle Fork Irrigation District and well water) do not contain bull trout or their habitat.

Adfluvial bull trout are present upstream of an impassible dam in the Middle Fork Hood River upstream of the Parkdale Fish facility. Therefore no interaction with hatchery spring Chinook salmon is likely. The release of full term hatchery spring Chinook smolts, with their rapid out migration from the Hood River, limits any interactions with fluvial bull trout in the mainstem and Middle Fork Hood River. The possibility for disease transfer between the two species is unknown but thought to be limited since HRPP smolts are not released unless they have received disease clearance from ODFW pathologists. It is possible that adult bull trout may use HRPP spring Chinook smolts as a prey base, potentially a benefit for the bull trout from this Chinook propagation program.

When adult trapping facilities are relocated during 2010, handling of adult bull trout will be further reduced or eliminated. Adult bull trout have not been documented in West Fork Hood River in the vicinity of the Moving Falls weir. The rearing/acclimation facility planned in the West Fork at the Moving Falls site should not negatively affect bull trout. The water intake will be screened to comply with NOAA standards. Rapidly out migrating full term smolts will be released volitionally and non-migrants will be transported to the mouth of the Hood River. Smolts will not be released unless they have received disease clearance from pathologists.

15.4) Actions taken to minimize potential effects.
Refer to section 15.3.

15.5) References

Buchanan, D.V., M.L. Hanson and R.M. Hooton. 1997. Status of Oregon's bull trout distribution, life history, limiting factors, management considerations and status. Oregon Department of Fish and Wildlife, Portland, Oregon.

Coccoli, H., editor. 2004. Hood River subbasin plan (including lower Oregon Columbia Gorge tributaries). Report to the Northwest Power and Conservation Planning Council, Portland, Oregon. http://www.nwcouncil.org/fw/subbasinplanning/hood/plan/Entire_document.pdf

Olsen, E.A. 2008. Hood River and Pelton Ladder evaluation studies. Annual Report 2007 of the Oregon Department of Fish and Wildlife (Project Number 1988-053-04) to Bonneville Power Administration, Portland, Oregon.

U. S. Fish and Wildlife Service 1998. Final rule to list Columbia River and Klamath River population segments of the bull trout as a threatened species. Federal Register 63:31647-31674.

U.S. Fish and Wildlife Service. 2003. Chapter 6, Mount Hood Recovery Unit, Oregon. 96 p. In: U.S. Fish and Wildlife Service. Bull Trout (Salvelinus confluentus) Recovery Plan. Portland, Oregon.

APPENDIX J: WINTER STEELHEAD HGMP

HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Hood River Production Program
Species or Hatchery Stock:	Steelhead
Agency/Operator:	Oregon Department of Fish and Wildlife / Confederated Tribes of Warm Springs Reservation of Oregon
Watershed and Region:	Hood River
Date Submitted:	April 30, 2008
Date Last Updated:	April 30, 2008

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Hood River Production Program (HRPP)

1.2) Species and population (or stock) under propagation, and ESA status.

Oncorhynchus mykiss, winter run steelhead (stock 050)

1.3) Responsible organization and individuals

Name (and Title): Rod A. French
Organization: Oregon Department of Fish and Wildlife (ODFW)
Address: 3701 W. 13th Street, The Dalles, Oregon 97058
Telephone: 541-296-4628
Fax: 541-298-4993
Email: rod.a.french@state.or.us

Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

The Hood River steelhead hatchery programs are implemented jointly by Oregon Department of Fish and Wildlife (ODFW) and the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO). The Hood River Watershed Group, the Northwest Service Academy/Americorps, and others volunteer to assist setup and takedown of portable acclimation facilities. The East Fork Irrigation District owns and operates the sand trap where the winter steelhead are acclimated. The U.S. Fish and Wildlife Service assists with the genetic distinction between the summer and winter steelhead ecotype. Oregon State University is a cooperator on studies of fitness and genotyping of winter steelhead.

1.4) Funding source, staffing level, and annual hatchery program operational costs.

Funding for this project is provided by the Bonneville Power Administration (BPA) and is part of the Hood River Production Project (HRPP). The HRPP is composed of many closely related projects that share responsibilities for rebuilding fish populations in the Hood River Subbasin through hatchery supplementation and habitat restoration. Due the interrelation of the slate of HRPP projects, projected costs for this proposed are dispersed amongst several projects. Projected annual operating costs for rearing steelhead at the Oak Springs Fish Hatchery are approximately $125,000. Projected annual operational costs for the trapping, adult holding, and spawning, are approximately $300,000. Projected annual M&E costs would be approximately $500,000.

1.5) Location(s) of hatchery and associated facilities.

<u>*Adult Collection:*</u>

A floating resistance board type of weir and trap located just downstream of the confluence of the Middle and East Forks. If it is determined that the trap site is not feasible, two weirs and traps will be constructed near the confluence of the Middle and East Forks of Hood River. Traps will be installed and operated seasonally (January 15 – May 30) during the migration period for winter steelhead. Fish can be sorted, enumerated, removed for broodstock, or passed upstream at the trapping site.

<u>*Spawning, rearing, acclimation and release:*</u>

The Hood River Fish facility is located near Parkdale on Rogers Spring Creek, tributary of the Middle Fork Hood River. Facilities include two adult holding ponds, two acclimation ponds, two Canadian rearing troughs, spawning and incubation facilities.

<u>*Egg incubation and rearing:*</u>

Oak Springs hatchery is located in the Deschutes River Canyon at RM 47.2, about 3 miles northeast of Maupin, Oregon. Site elevation is 850 feet above sea level (Lewis 1996). Winter steelhead eggs are transferred from Parkdale to Oak Springs Hatchery for incubation and rearing.

<u>*Acclimation and release:*</u>

East Fork Irrigation acclimation site is located on the East Fork Hood River at RM 10.0. Approximately 50,000 winter steelhead are transported from Oak Springs Hatchery to the acclimation site. Acclimation and volitional release is done in one of the concrete settling ponds for the irrigation diversion. Non-migrants are trucked and released at the mouth of Hood River.

<u>*Acclimation and release:*</u>

A likely fish barrier waterfall developed in the lower reaches of the Middle Fork of Hood River in 2006. The longevity of the falls is unknown, if the waterfall no longer acts as a barrier, approximately 25% of the hatchery production will be released from the Parkdale Fish Facility (RM 3.5). Fish will be acclimated at the Parkdale Fish Facility in one of the concrete ponds and volitionally released into Rogers Spring Creek. Non-migrants are trucked to the mouth of Hood River and released.

1.6) Type of program.

The Hood River winter steelhead (stock 050) fish propagation projects are managed by CTWS and ODFW as an integrated hatchery program.

1.7) Purpose (Goal) of program.

The primary goal for the winter steelhead program is to provide harvest opportunity for sport and tribal anglers. Harvest opportunity for steelhead and salmon in the Hood River basin is currently limited to hatchery summer steelhead, winter steelhead and spring Chinook. After the removal of Powerdale Dam, only hatchery winter steelhead and spring Chinook will be available for harvest. The goal of the HRPP winter steelhead supplementation has been to increase natural production without changing the genetic makeup of the wild or naturally spawning population. The current brood stock collection goal is 70 adults for the production of 50,000 smolts. In accordance with wild fish protection policies, no more than 25% of the wild run is taken for broodstock.

1.8) Justification for the program.

The Hood River Production Program (HRPP), steelhead component, will use artificial production of Hood River native stock winter steelhead to increase the number of winter steelhead in the Hood River while maintaining the long-term fitness of the target populations and minimizing the ecological and genetic impacts on non-target populations within the Hood River subbasin.

The removal of Powerdale Dam and the associated Fish Trapping Facility in 2010, will dictate significant alterations to the current hatchery production and operations associated with the HRPP. Previously this HGMP described winter and summer run hatchery production project that relied upon the operation of the Powerdale Fish Trapping Facility for fish sorting and broodstock collection. In 2007, basin co-managers developed a revised Master Plan for the HRPP (HDR, FishPro, 2007) describing program changes required following the removal of Powerdale Dam , along with recommended program changes following a programmatic review of the HRPP accomplishments (Underwood et al. 2003). This HGMP describes the hatchery steelhead program changes. Significant changes from the current Hood River steelhead HGMP include the cessation of the summer steelhead hatchery program and changes in the fish sorting and broodstock collection point for the remaining winter steelhead hatchery program. Proposed changes to the winter steelhead program described in this document will be effective in 2010 following the removal of Powerdale Dam. Broodstock collection for the existing Hood River summer run steelhead program was discontinued with 2008-09 run year returns.

1.9) List of program "Performance Standards".

All "Performance Standards" listed in the APR's Performance Standards and Indicators for the Use of Artificial Production for Anadromous and Resident Fish Populations in the Pacific Northwest are followed.

Performance standards for the steelhead component of the Hood River Production Program include: 1) rebuild the naturally self-sustaining run of Hood River winter steelhead with an annual run of 656 wild origin fish to Hood River, with a hatchery escapement of 1,000 fish for in-river sport and tribal fish harvest; 2) maintain the genetic character of naturally producing populations of native and re-established salmonids in the Hood River subbasin; and 3) monitor several performance standards to evaluate the HRPP's benefit to ESA listed species in the Hood River subbasin. 4) Contribute to sport and tribal fisheries. 5) Aid in the recovery of ESA listed Hood River steelhead.

Individual Performance standards are summarized according to the Research Objectives identified in **SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS.**

1.10) List of program "Performance Indicators", designated by "benefits" and "risks."

1.10.1) "Performance Indicators" addressing benefits.

Smolt to adult survival will be assessed based on monitoring of natural and hatchery smolt emigration from the subbasin and adult returns observed at the Powerdale Fish Facility and in the Hood River sport fishery.

The research component of the HRPP monitors several performance indicators to evaluate the HRPP's benefit to ESA listed species in the Hood River subbasin. Performance indicators are summarized according to the Research Objectives identified in **SECTION 11.1 Monitoring and evaluation of "Performance Indicators" presented in Section 1.10**.

Strategy 1

1-1) Harvest will be estimated for fisheries existing both pre- and post- Powerdale Dam to evaluate the effectiveness of the Hood River steelhead supplementation program. No fishery currently exists above RM 4.5; the existing site of Powerdale Dam.

Strategy 2

2-1) Wild and subbasin hatchery produced adult winter steelhead will be counted and bio-sampled at both pre- and post- Powerdale Dam adult collection facilities. Estimates of escapement to the adult collection facilities will be combined with estimates of harvest (see 1-1) to estimate escapements to the mouth of the Hood River. Numbers passed above adult collection facilities will be used to estimate spawner escapements to the Hood River subbasin. Data will be used to 1) determine if the HRPP is achieving the programs defined escapement objectives for wild and subbasin hatchery produced winter steelhead, 2) determine if the HRPP is producing a hatchery smolt that has a survival rate similar to that of wild steelhead (see 3-1 and 3-2), 3) determine if the HRPP is achieving the programs defined smolt-to-adult survival rate (see 3-1); and 3) evaluate acclimation facilities to determine if volitionally released acclimated hatchery smolts have a higher smolt-to-adult survival rate than hatchery smolts directly released into the subbasin (see 3-3).

Strategy 3

3-1) Smolt-to-adult survival rates will be estimated for subbasin hatchery production releases to determine if the HRPP is achieving the programs defined smolt-to-adult survival rate.

3-2) Downstream migrant traps will be used to estimate numbers of wild rainbow-steelhead moving past selected areas of the Hood River subbasin. Estimates will be used to determine the number of smolts produced in the Hood River subbasin; in the West, Middle, and East forks of the Hood River subbasin; and in Neal Creek, Lake Branch, and Green Point Creek. Data will be used to determine if the HRPP is successfully achieving its defined goal of restoring depressed populations of wild summer and winter steelhead in the Hood River subbasin to levels commensurate with the subbasins current carrying capacity.

3-3) A downstream migrant trap will be operated in the mainstem of the Hood River at RM 4.5 to estimate numbers of subbasin hatchery produced summer and winter steelhead moving out of the Hood River subbasin. Data will be used to

1) determine what percentage of the hatchery production groups residualize in the subbasin and 2) better estimate out-of-basin smolt to adult survival rate.

1.10.2) "Performance Indicators" addressing risks.
The research component of the HRPP monitors several performance indicators to evaluate the HRPP's impact (i.e., risk) on indigenous populations of fish in the Hood River subbasin. Performance indicators used to evaluate the HRPP's potential risk to ESA listed species are summarized according to the Research Objectives identified in **SECTION 11.1 Monitoring and evaluation of "Performance Indicators" presented in Section 1.10**.

Strategy 4

4-1) Age structure, mean fork length, mean weight, and mean condition factor are estimated at Oak Springs Hatchery for hatchery summer and winter steelhead smolts destined for release in the Hood River subbasin. Mean estimates are compared between wild steelhead and subbasin hatchery produced winter steelhead (see 4-2) to determine if the selected morph metric and meristic characteristics of the subbasin hatchery stocks are the same as, or dissimilar to, estimates for the wild population.

4-2) Age structure, mean fork length, mean weight, and mean condition factor are estimated at downstream migrant traps for both pre-smolt and smolt wild steelhead. Mean estimates are compared between wild steelhead and subbasin hatchery produced winter steelhead (see 4-1) to determine if the selected morph metric and meristic characteristics of the subbasin hatchery stocks are the same as, or dissimilar to, estimates for the wild population.

4-3) Temporal distribution of migration is estimated for pre-smolt and smolt wild steelhead and subbasin hatchery produced summer and winter steelhead sampled at migrant traps located in the Hood River subbasin. Data are used to determine if hatchery smolts have a migration pattern similar to that of wild steelhead smolts.

4-4) Age structure, sex ratio, mean fork length, and mean weight will be estimated at adult collection facilities for both wild and subbasin hatchery adult winter steelhead. Mean estimates will be compared between wild and subbasin hatchery produced adult summer and winter steelhead to determine if the selected morph metric and meristic characteristics of the subbasin hatchery stocks are the same as, or dissimilar to, estimates for the wild population. Estimates of age structure are also used in determining if fisheries below adult collection facilities are disproportionately harvesting specific age categories of returning wild and subbasin hatchery produced summer and winter steelhead (see 4-10).

4-5) Temporal distribution of migration will be monitored for wild and subbasin hatchery adult winter steelhead escaping to adult collection facilities. Data are used to determine if migration timing of the hatchery stocks are similar to that of the wild population.

4-6) Spatial distribution of the indigenous population is determined from radio tagged wild adult summer and winter steelhead. Data is used to identify where hatchery summer and winter steelhead should be released into the Hood River subbasin.

4-7) Coded wire and/or PIT tags are recovered/detected from summer and winter steelhead sampled at adult collection facilities, in the creel, and from adults used for hatchery broodstock. Data are summarized to 1) determine the extent to which non-indigenous stocks stray into the Hood River subbasin, 2) identify the potential for non-indigenous stocks to spawn in the subbasin, 3) identify if non-indigenous stocks are incorporated into the hatchery broodstock so that eggs can be destroyed, 4) monitor movement past Bonneville Dam, and 5) estimate harvest in the Bonneville pool.

4-8) Out-of-subbasin recoveries/detections of coded wire and/or PIT tagged hatchery summer and winter steelhead are summarized for subbasin hatchery summer and winter steelhead released as smolts in the Hood River subbasin. Hatchery summer steelhead smolts are currently not coded wire tagged prior to release but hatchery production releases are PIT tagged. Data will be used to determine if the HRPP's hatchery production releases stray at a disproportionately higher rate than for other hatchery programs located in the general geographic area of the Hood River subbasin.

4-9) Out-of-subbasin recoveries/detections of floy and PIT tagged fish will be summarized for "recycled" summer and winter steelhead. Data will also be used to monitor the straying rate of "recycled" adults.

4-10) Age structure will be monitored for adult summer and winter steelhead harvested in Hood River fisheries. Data will be used to determine if the fishery is disproportionately harvesting specific age categories in either the wild or subbasin hatchery components of the adult summer and winter steelhead runs. The selective harvest of specific age categories would ultimately modify the age structure of the population of wild and subbasin hatchery produced summer and winter steelhead escaping to the spawning grounds (see 4-1).

Strategy 5

5-1) Genetic samples will be collected from pre-smolt and smolt steelhead and rb-st at selected sites in the Hood River subbasin (*see* **Strategy 3**). Data will be used to identify and characterize populations in the Hood River subbasin and to identify guidelines for minimizing the HRPP's impact on indigenous populations of summer and winter steelhead.

5-2) Genetic samples will be collected from all adult summer and winter steelhead passed above adult collection facilities and for all winter steelhead used for hatchery broodstock (*see* **Strategy 2**). Data will be used to 1) characterize wild and subbasin hatchery populations currently present in the Hood River subbasin, 2) determine the impact past hatchery practices have had on the indigenous population, and 3) monitor any impact the current hatchery program (i.e., the HRPP's) may be having on the indigenous populations.

5-3) Genetic analysis of tissue samples taken from adult steelhead collected for hatchery broodstock will be used to more accurately identify race (*see* 5-2).

5-4) Genetic analysis of tissue samples taken from downstream migrant rb-st (*see* 5-1) will be used as the basis for developing a model for more accurately determining the race of adult steelhead collected for hatchery broodstock (*see* 5-3)

Strategy 6

6-1) Habitat will be monitored throughout the Hood River subbasin to evaluate changes in subbasin carrying capacity.

Strategy 7

7-1) Genetic samples will be collected from pre-smolt and smolt redband/rainbow trout, cutthroat trout, and bull trout, at selected sites in the Hood River subbasin (*see* **Strategy 3**). Data will be used to identify and characterize populations in the Hood River subbasin and to identify guidelines for minimizing the HRPP's impact on indigenous populations of summer and winter steelhead and anadromous and resident cutthroat trout.

1.11) Expected size of program.

1.11.1) Proposed annual broodstock collection level (maximum number of adult fish).

Long term (potential) broodstock collection goals are: Winter Steelhead – wild up to 60, Hood hatchery stock 20, Total 80

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location.

A maximum of 50,000, one-year old smolts will be released into the Hood River. All smolts will be acclimated for a minimum of fourteen days prior to a volitional release strategy. Two acclimated release sites will be utilized in the Hood River Basin, with release into the East and Middle Forks. In the East Fork of Hood River, fish will be acclimated and released from the sand settling facility at the East Fork Irrigation District irrigation diversion on the East Fork of Hood River (RM 6.0?). The Middle Fork release and acclimation site will be from the Parkdale Fish Facility (Middle Fork Hodo River RM 3.5) located on Rogers Spring Creek. Approximately 60% of total production will be released into East Fork, with the remaining 40% being released into the Middle Fork. In 2006, a glacial flood originating in the upper reaches of the Middle Fork, created a fish barrier waterfall in the lower reach of the Middle Fork of Hood River (RM 1.0). The longevity of this newly formed barrier is unknown, however, until the barrier again becomes passable to winter steelhead all releases will be made into the East Fork.

Winter Steelhead

Life Stage	Release Location	Annual Release Level
Eyed Eggs	NA	NA
Unfed Fry	NA	NA
Fry	NA	NA
Fingerling	NA	NA
Yearling	Middle Fork Hood River	Pending evaluation of barrier falls.
Yearling	East Fork Hood River	50,000

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

Tables 1 and 2 present escapement and smolt to adult return data collected from Powerdale Dam for hatchery and wild origin summer and winter steelhead. Data is collected and compiled by the HRPP Monitoring and Evaluation Program (Olson, 2008).

Table 1. Adult summer steelhead escapements to the Powerdale Fish Facility by origin, brood year, and ocean age category. Brood years are boldfaced for those years in which brood year specific estimates of escapement are complete. (Percent return is in parentheses. Estimates are based on returns in the 1992-1993 through 2007-2008[a] run years.) Data source: Olsen (2008).

Origin, Stock, brood year[b]	Smolts	Ocean Age: 1 Salt	2 Salt	3 Salt	4 Salt	Repeat Spawners
Wild,						
Hood River,						
1986	--	--	1	0	0	4
1987	--	0	77	55	3	20
1988	--	6	353	65	0	15
1989	--	31	183	37	0	8
1990	--	13	93	20	0	5
1991	--	8	104	14	0	5
1992	--	16	142	7	0	10
1993	1,222	8 (0.65)	60 (4.91)	16 (1.31)	0	8 (0.65)
1994	2,805	9 (0.32)	93 (3.32)	21 (0.75)	0	14 (0.50)
1995	5,536	19 (0.34)	169 (3.05)	10 (0.18)	1 (0.02)	14 (0.25)
1996	3,885	32 (0.82)	139 (3.58)	28 (0.72)	0	27 (0.70)
1997	8,731	61 (0.70)	498 (5.70)	54 (0.62)	0	40 (0.46)
1998	4,035	89 (2.21)	379 (9.39)	18 (0.45)	0	24 (0.59)
1999	2,000	68 (3.40)	186 (9.30)	17 (0.85)	0	10 (0.50)
2000	3,448	52 (1.51)	178 (5.16)	11 (0.32)	0	11 (0.32)
2001	3,475	28 (0.81)	111 (3.19)	26 (0.75)	0	2 (0.06)
2002	3,104	47 (1.51)	100 (3.22)	17 (0.55)	0	3 (0.10)
2003	--	36	117	1	--	--
2004	--	19	5	--	--	--
2005	--	--	--	--	--	--
Subbasin hatchery,						
Foster,						
1987	79,867	--	--	1 (0.001)	1 (0.001)	--
1988	89,026	--	--	150 (0.17)	3 (0.003)	13 (0.01)
1989	81,795	--	1,513 (1.85)	235 (0.29)	0	7 (0.01)
1990	77,132	48 (0.06)	819 (1.06)	256 (0.33)	0	11 (0.01)
1991	99,973	35 (0.04)	1,344 (1.34)	57 (0.06)	0	15 (0.02)
1992	70,928	12 (0.02)	425 (0.60)	76 (0.11)	0	10 (0.01)
1993	90,042	59 (0.07)	1,240 (1.38)	36 (0.04)	0	10 (0.01)
1994	76,330	8 (0.01)	543 (0.71)	140 (0.18)	1 (0.001)	18 (0.02)
1995	68,378	10 (0.01)	374 (0.55)	76 (0.11)	0	10 (0.01)
1996	60,993	28 (0.05)	362 (0.59)	54 (0.09)	0	15 (0.02)
1997	64,910	33 (0.05)	1,212 (1.87)	189 (0.29)	0	18 (0.03)
1998	62,218	43 (0.07)	1,463 (2.35)	75 (0.12)	0	34 (0.05)
1999	49,278	82 (0.17)	1,413 (2.87)	104 (0.21)	1 (0.002)	29 (0.06)
2000	62,354	117 (0.19)	1,131 (1.81)	94 (0.15)	2 (0.003)	31 (0.05)

Table 1 (cont.). Adult summer steelhead escapements to the Powerdale Fish Facility by origin, brood year, and ocean age category. Brood years are boldfaced for those years in which brood year specific estimates of escapement are complete. (Percent return is in parentheses. Estimates are based on returns in the 1992-1993 through 2007-2008[a] run years.) Data source: Olsen (2008).

Origin, Stock, brood year[b]	Smolts	Ocean Age 1 Salt	2 Salt	3 Salt	4 Salt	Repeat Spawners
2001	58,711	66 (0.11)	1,681 (2.86)	114 (0.19)	1 (0.002)	7 (0.01)
2002	28,981	26 (0.09)	441 (1.52)	76 (0.26)	1 (0.003)	6 (0.02)
2003	18,730	29 (0.15)	346 (1.85)	23 (0.12)	--	1 (0.005)
2004	31,269	32 (0.10)	258 (0.83)	--	--	--
2005	32,148	14 (0.04)	--	--	--	--
2006	63,486	--	--	--	--	--
Hood River,[c]						
1998	19,513	26 (0.13)	416 (2.13)	100 (0.51)	0	20 (0.10)
1999	33,899	111 (0.33)	626 (1.85)	80 (0.24)	0	22 (0.06)
2000	37,665	33 (0.09)	369 (0.98)	66 (0.18)	7 (0.02)	14 (0.04)
2001	45,658	191 (0.42)	861 (1.89)	210 (0.46)	0	19 (0.04)
2002	47,513	52 (0.11)	347 (0.73)	79 (0.17)	1 (0.002)	4 (0.008)
2003	40,429	62 (0.15)	356 (0.88)	37 (0.09)	--	5 (0.01)
2004	49,956	88 (0.18)	345 (0.69)	--	--	--
2005	34,049	93 (0.27)	--	--	--	--
2006[d]	0	--	--	--	--	--
Hood River (Unknown),[e]						
1996	*f*	--	--	--	1	0
1997	*f*	--	--	3	0	0
1998	*f*	--	5	43	0	2
1999	*f*	9	29	4	0	1
2000	*f*	1	4	1	0	0
2001	*f*	1	2	23	1	0
2002	*f*	4	21	13	0	1
2003	*f*	5	40	15	--	0
2004	*f*	13	12	--	--	--
2005	*f*	0	--	--	--	--

[a] Estimates for the 2007-2008 run year are preliminary estimates through 12 February, 2008.

[b] Complete brood returns are available beginning with the 1989 wild and 1990 hatchery broods, as determined based on age structure for adult summer steelhead sampled at the Powerdale Fish Facility. Estimates of escapement for prior brood years do not include adult returns from all possible age categories.

[c] Hood River stock hatchery smolts are volitionally released from acclimation facilities located in the Hood River subbasin. Hatchery smolts are held at the facilities for up to two weeks prior to release.

[d] No Hood River stock hatchery summer steelhead were released from the 2006 brood.

[e] Numbers include adults that had a valid Hood River stock winter steelhead mark combination, but were classified as a summer steelhead. These adults are believed to be either 1) the progeny of winter and summer steelhead crosses, 2) mis-identified Hood River stock winter steelhead, or 3) stray summer steelhead. Adults were aged back to brood year as if they were summer steelhead.

[f] Returning adults are not assigned to a particular subbasin hatchery production release because the b rood stock of origin is unknown; although it is believed that they are returns from a Hood River stock subbasin production release of winter steelhead.

Table 2. Adult winter steelhead escapements to the Powerdale Fish Facility by origin, stock, brood year, and ocean age category. (Percent return is in parentheses. Brood years are bold faced for those years in which brood year specific estimates of escapement are complete. Estimates are based on returns in the 1991-1992 through 2006-2007 run years.) Data source: Olsen (2008).

Origin, stock, brood year[a]	Smolts	Ocean Age				Repeat Spawners
		1 Salt	2 Salt	3 Salt	4 Salt	
Wild,						
Hood River,						
1985	--	--	--	--	--	2
1986	--	--	1	17	0	18
1987	--	--	111	94	1	39
1988	--	1	444	129	1	29
1989	--	10	193	87	1	14
1990	--	38	284	46	0	16
1991	--	12	131	37	1	8
1992	--	29	209	40	0	11
1993	4,397	21 (0.48)	228 (5.19)	54 (1.23)	0	13 (0.30)
1994	4,560	15 (0.33)	157 (3.44)	40 (0.88)	1 (0.02)	10 (0.22)
1995	7,662	15 (0.20)	195 (2.54)	56 (0.73)	1 (0.01)	35 (0.46)
1996	22,509	55 (0.24)	911 (4.05)	153 (0.68)	0	142 (0.63)
1997	13,840	21 (0.15)	788 (5.69)	168 (1.21)	0	40 (0.29)
1998	7,239	30 (0.41)	678 (9.37)	197 (2.72)	1 (0.01)	36 (0.50)
1999	3,761	25 (0.66)	495 (13.2)	99 (2.63)	0	24 (0.64)
2000	5,940	12 (0.20)	409 (6.89)	86 (1.45)	2 (0.03)	6 (0.10)
2001	8,578	9 (0.10)	300 (3.50)	109 (1.27)	0	19 (0.22)
2002	6,072	10 (0.16)	258 (4.25)	91 (1.50)	0	3 (0.05)
2003	--	31	300	21	--	--
2004	--	4	6	--	--	--
Subbasin hatchery,						
Big Creek,						
1987	28,000	--	--	1 (0.004)	--	2 (0.007)
1988	4,890	--	5 (0.10)	6 (0.12)	--	3 (0.06)
1989	36,038	--	281 (0.78)	137 (0.38)	1 (0.003)	10 (0.03)
1990	20,434	--	129 (0.63)	72 (0.35)	--	7 (0.03)
Mixed,[b]						
1991	4,595	6 (0.13)	20 (0.44)	2 (0.04)	--	0
Hood River,[c]						
1992	48,985	1 (0.002)	77 (0.16)	17 (0.03)	0	1 (0.002)
1993	38,034	12 (0.03)	251 (0.66)	99 (0.26)	0	12 (0.03)
1994	42,860	10 (0.02)	526 (1.23)	128 (0.30)	1 (0.002)	12 (0.03)
1995	50,896	8 (0.02)	255 (0.50)	120 (0.24)	2 (0.004)	14 (0.03)

Table 2 (cont.). Adult winter steelhead escapements to the Powerdale Fish Facility by origin, stock, brood year, and ocean age category. (Percent return is in parentheses. Brood years are bold faced for those years in which brood year specific estimates of escapement are complete. Estimates are based on returns in the 1991-1992 through 2006-2007 run years.) Data source: Olsen (2008).

Origin, stock, brood year[a]	Smolts	Ocean Age				Repeat Spawners
		1 Salt	2 Salt	3 Salt	4 Salt	
1996	59,837	3 (0.005)	171 (0.29)	47 (0.08)	0	16 (0.03)
1997	62,135	12 (0.02)	221 (0.36)	158 (0.25)	0	26 (0.04)
1998	46,781	8 (0.02)	718 (1.53)	202 (0.43)	0	10 (0.02)
1999	63,182	10 (0.02)	738 (1.17)	185 (0.29)	1 (0.002)	13 (0.02)
2000	50,879	4 (0.008)	290 (0.57)	119 (0.23)	1 (0.002)	10 (0.02)
2001	62,921	12 (0.02)	860 (1.37)	206 (0.33)	1 (0.002)	20 (0.03)
2002	51,433	3 (0.006)	237 (0.46)	137 (0.27)	4 (0.008)	2 (0.004)
2003	59,407	17 (0.03)	741 (1.25)	176 (0.30)	--	3 (0.005)
2004	79,486	5 (0.006)	240 (0.30)	--	--	--
2005	36,795	3 (0.008)	--	--	--	--
2006	38,360	--	--	--	--	--
Hood River (Unknown),[d]						
1998	*e*	0	5	19	0	2
1999	*e*	0	137	18	0	1
2000	*e*	5	12	0	0	0
2001	*e*	0	5	12	0	0
2002	*e*	0	48	1	0	0
2003	*e*	0	3	10	--	--
2004	*e*	1	13	--	--	--
2005	*e*	1	--	--	--	--

[a] Complete brood returns are available beginning with the 1989 wild and 1990 hatchery broods, as determined based on age structure for adult winter steelhead sampled at the Powerdale Fish Facility. Estimates of escapement for prior brood years do not include adult returns from all possible age categories.

[b] Returns from the 1991 brood are progeny of wild x Big Creek stock hatchery crosses.

[c] Beginning with the 1995 brood release, hatchery smolts were volitionally released from acclimation facilities located in the Hood River subbasin. Hatchery smolts were held at the facilities for one to two weeks prior to release.

[d] Numbers include adults that had a valid Hood River stock summer steelhead mark combination but were classified as a winter steelhead. These adults are believed to be either 1) the progeny of summer and winter steelhead crosses or 2) mis-identified Hood River stock summer steelhead. Adults were aged back to brood year as if they were winter steelhead.

[e] Returning adults are not assigned to a particular subbasin hatchery production release because the brood stock of origin is unknown; although it is believed that they are returns from a Hood River stock subbasin production release of summer steelhead.

Table 3. Adult summer steelhead escapements to the Powerdale Dam trap by origin, run year, and age category. Fish of unknown origin were allocated to origin categories based on scale analysis and the ratio of fish of known origin. Data source: Olsen (2008).

Origin, stock, run year	Total escapement	Freshwater/ocean age														Repeat spawners
		1/1	2/1	3/1	4/1	½	2/2	3/2	4/2	5/2	1/3	2/3	3/3	¼	2/4	
Wild,																
Hood River,																
1992-1993	490	0	26	6	0	5	309	77	1	0	0	48	0	--	0	18
1993-1994	245	0	11	5	0	1	109	44	0	0	2	53	7	--	3	10
1994-1995	218	0	5	2	0	0	81	69	0	0	0	34	12	--	0	15
1995-1996	132	0	14	3	0	0	82	11	0	0	0	18	1	--	0	3
1996-1997	184	0	7	2	0	2	129	22	0	0	0	14	2	--	0	6
1997-1998	81	0	8	1	0	1	44	13	0	0	0	7	0	--	0	7
1998-1999	132	0	13	1	0	2	75	14	0	0	0	15	0	--	0	12
1999-2000	188	2	26	6	0	1	107	16	0	0	0	19	1	--	0	10
2000-2001	221	0	23	6	0	4	101	59	1	0	2	6	2	--	0	17
2001-2002	494	4	72	36	0	1	314	33	0	0	1	12	4	--	1	16
2002-2003	708	2	52	17	0	24	320	180	4	1	3	49	14	--	0	42
2003-2004	266	0	41	12	0	3	111	58	0	0	1	13	4	--	0	23
2004-2005	233	0	13	8	0	3	120	50	0	0	0	16	2	--	0	21
2005-2006	206	3	36	15	1	3	74	55	1	0	0	11	0	--	0	7
2006-2007	197	0	22	11	0	10	84	34	0	0	4	24	0	--	0	8
2007-2008[a]	176	0	19	11	0	5	107	13	0	0	1	13	2	--	0	5
Subbasin hatchery,																
Foster,																
1992-1993	1,726	48	0	--	--	1,513	0	--	--	--	150	1	--	1	--	13
1993-1994	1,098	35	0	--	--	818	0	--	--	--	235	0	--	3	--	7
1994-1995	1,624	12	0	--	--	1,343	1	--	--	--	256	0	--	0	--	12
1995-1996	546	59	0	--	--	419	1	--	--	--	57	0	--	0	--	10
1996-1997	1,344	8	0	--	--	1,240	6	--	--	--	76	0	--	0	--	14
1997-1998	594	10	0	--	--	543	0	--	--	--	36	0	--	0	--	5
1998-1999	556	25	0	--	--	374	0	--	--	--	140	0	--	0	--	17
1999-2000	485	33	3	--	--	360	0	--	--	--	76	0	--	1	--	12
2000-2001	1,176	34	0	--	--	1,077	2	--	--	--	49	0	--	0	--	14
2001-2002	1,879	77	9	--	--	1,442	135	--	--	--	188	5	--	0	--	23
2002-2003	1,655	116	5	--	--	1,408	21	--	--	--	75	1	--	0	--	29
2003-2004	1,327	65	1	--	--	1,123	5	--	--	--	103	0	--	0	--	30
2004-2005	1,834	26	1	--	--	1,680	8	--	--	--	94	1	--	1	--	23
2005-2006	608	29	0	--	--	441	1	--	--	--	114	0	--	2	--	21
2006-2007	456	32	0	--	--	344	0	--	--	--	76	0	--	1	--	3
2007-2008[a]	300	14	0	--	--	258	2	--	--	--	23	0	--	1	--	2
Hood River,																
2000-2001	7	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2001-2002	417	110	19	--	--	288	--	--	--	--	--	--	--	--	--	0
2002-2003	910	31	1	--	--	626	128	--	--	--	100	--	--	--	--	24
2003-2004	656	191	2	--	--	368	0	--	--	--	80	--	--	--	--	15
2004-2005	995	52	0	--	--	861	1	--	--	--	66	--	--	--	--	15

Origin, stock, run year	Total escapement	Freshwater/ocean age														Repeat spawners
		1/1	2/1	3/1	4/1	½	2/2	3/2	4/2	5/2	1/3	2/3	3/3	¼	2/4	
2005-2006	645	62	0	--	--	347	0	--	--	--	210	--	--	7	--	19
2006-2007	526	87	0	--	--	356	0	--	--	--	79	--	--	0	--	4
2007-2008[a]	484	93	1	--	--	345	0	--	--	--	37	--	--	1	--	7
Hood River (Unknown),[b]																
2001-2002	9	6	0	--	--	1	0	--	--	--	2	0	--	0	--	0
2002-2003	84	1	3	--	--	29	4	--	--	--	43	1	--	1	--	2
2003-2004	10	1	0	--	--	4	0	--	--	--	4	0	--	0	--	1
2004-2005	7	4	0	--	--	2	0	--	--	--	1	0	--	0	--	0
2005-2006	49	5	0	--	--	21	0	--	--	--	23	0	--	0	--	0
2006-2007	66	13	0	--	--	40	0	--	--	--	13	0	--	0	--	0
2007-2008[a]	29	0	0	--	--	12	0	--	--	--	15	0	--	1	--	1
Stray hatchery, Unknown,																
1992-1993	5	3	--	0	--	2	0	0	--	--	0	0	--	0	--	0
1993-1994	13	1	--	0	--	10	0	0	--	--	2	0	--	0	--	0
1994-1995	4	0	--	0	--	1	0	0	--	--	3	0	--	0	--	0
1995-1996	5	2	--	0	--	0	0	0	--	--	2	0	--	0	--	1
1996-1997	18	1	--	0	--	16	0	0	--	--	1	0	--	0	--	0
1997-1998	6	2	--	0	--	4	0	0	--	--	0	0	--	0	--	0
1998-1999	11	1	--	0	--	8	0	0	--	--	2	0	--	0	--	0
1999-2000	2	0	--	0	--	2	0	0	--	--	0	0	--	0	--	0
2000-2001	11	0	--	0	--	9	1	0	--	--	1	0	--	0	--	0
2001-2002	30	0	--	2	--	0	8	0	--	--	14	0	--	0	--	6
2002-2003	25	3	--	0	--	9	1	1	--	--	0	4	--	0	--	7
2003-2004	12	1	--	0	--	6	1	0	--	--	3	0	--	0	--	1
2004-2005	27	6	--	0	--	19	0	0	--	--	1	0	--	0	--	1
2005-2006	14	6	--	0	--	1	0	0	--	--	0	0	--	3	--	4
2006-2007	39	0	--	0	--	20	0	0	--	--	19	0	--	0	--	0
2007-2008[a]	3	0	--	0	--	3	0	0	--	--	0	0	--	0	--	0

[a] Preliminary estimate through 12 February, 2008.

[b] Adult steelhead with a valid Hood River stock winter steelhead mark, but were classified as a summer steelhead based on run timing and visual characteristics.

Table 4. Adult winter steelhead escapements to the Powerdale Dam trap by origin, run year, and age category. Fish of unknown origin were allocated to origin categories based on scale analysis and the ratio of fish of known origin. Data source: Olsen (2008).

Origin, stock, run year	Total escapement	Freshwater/ocean age 1/1	2/1	3/1	1/2	2/2	3/2	4/2	1/3	2/3	3/3	1/4	2/4	3/4	Repeat spawner
Wild, Hood River,															
1991-1992	697	--	9	1	3	424	111	1	4	77	17	0	0	0	50
1992-1993	415	--	37	1	2	173	20	0	6	123	17	0	1	0	35
1993-1994	404	--	9	1	2	273	17	0	6	78	2	0	0	0	16
1994-1995	206	--	28	3	1	107	9	0	1	34	3	0	1	1	18
1995-1996	279	--	18	1	11	183	21	0	1	29	6	1	0	0	8
1996-1997	290	--	12	3	1	197	25	1	1	35	7	0	0	0	8
1997-1998	227	--	13	3	1	133	20	0	0	42	4	0	0	0	11
1998-1999	298	--	54	2	8	153	23	0	0	38	11	0	0	0	9
1999-2000	921	--	5	1	4	790	40	0	1	43	2	0	1	0	34
2000-2001	1,015	--	21	16	3	581	113	1	1	128	13	0	1	0	137
2001-2002	1,059	--	22	9	12	607	203	0	5	137	24	0	0	0	40
2002-2003	745	--	12	3	5	411	68	0	5	171	30	0	0	0	40
2003-2004	597	--	7	0	18	357	72	0	4	87	21	0	1	0	30
2004-2005	345	--	8	2	4	197	47	0	12	59	7	0	0	0	9
2005-2006	460	--	30	2	6	226	85	0	2	73	23	0	2	0	11
2006-2007	476	--	4	1	6	294	28	0	21	89	24	0	0	0	9
Subbasin hatchery,															
Big Creek,															
1991-1992	298	--	--	--	281	5	--	--	6	1	--	0	--	--	5
1992-1993	209	--	--	--	63	0	--	--	137	0	--	0	--	--	9
1993-1994	137	--	--	--	--	66	--	--	65	0	--	1	--	--	5
1994-1995	10	--	--	--	--	--	--	--	--	7	--	0	--	--	3
Mixed,[a]															
1992-1993	6	6	--	--	--	--	--	--	--	--	--	--	--	--	--
1993-1994	14	--	--	--	14	--	--	--	--	--	--	--	--	--	--
1994-1995	8	--	--	--	--	6	--	--	2	--	--	--	--	--	--

Origin, stock, run year	Total escapement	Freshwater/ocean age 1/1	2/1	3/1	1/2	2/2	3/2	4/2	1/3	2/3	3/3	1/4	2/4	3/4	Repeat spawner
Hood River,															
1993-1994[b]	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--
1994-1995	90	12	0	--	77	--	--	--	--	--	--	--	--	--	1
1995-1996	274	10	0	--	247	0	--	--	17	--	--	--	--	--	0
1996-1997	636	7	0	--	523	4	--	--	98	0	--	0	--	--	4
1997-1998	389	3	1	--	239	3	--	--	128	1	--	0	0	--	14
1998-1999	317	12	0	--	160	16	--	--	116	0	--	1	0	--	12
1999-2000	301	6	0	--	216	11	--	--	47	4	--	1	0	--	16
2000-2001	917	7	2	--	711	5	--	--	158	0	--	0	1	--	33
2001-2002	954	3	3	--	730	7	--	--	199	0	--	0	0	--	12
2002-2003	502	11	1	--	285	8	--	--	185	3	--	0	0	--	9
2003-2004	999	3	1	--	857	5	--	--	119	0	--	1	0	--	13
2004-2005	481	16	0	--	236	3	--	--	206	0	--	1	0	--	19
2005-2006	888	5	1	--	741	1	--	--	137	0	--	1	0	--	2
2006-2007	427	3	0	--	240	0	--	--	176	0	--	4	0	--	4
Hood River (Unknown),[c]															
2000-2001	3	0	0	--	3	0	--	--	0	0	--	0	0	--	0
2001-2002	163	5	0	--	135	2	--	--	19	0	--	0	0	--	2
2002-2003	32	0	0	--	11	2	--	--	18	0	--	0	0	--	1
2003-2004	6	0	0	--	5	1	--	--	0	0	--	0	0	--	0
2004-2005	60	0	0	--	48	0	--	--	12	0	--	0	0	--	0
2005-2006	5	1	0	--	3	0	--	--	1	0	--	0	0	--	0
2006-2007	24	1	0	--	13	0	--	--	10	0	--	0	0	--	0
Stray hatchery,															
Unknown,															
1991-1992	22	0	0	--	8	0	--	--	13	0	--	0	--	--	1
1992-1993	21	0	0	--	15	0	--	--	5	0	--	0	--	--	1
1993-1994	24	0	0	--	2	1	--	--	21	0	--	0	--	--	0
1994-1995	3	0	0	--	1	0	--	--	2	0	--	0	--	--	0
1995-1996	6	0	0	--	5	0	--	--	0	0	--	0	--	--	1

Origin, stock, run year	Total escapement	Freshwater/ocean age													Repeat spawner
		1/1	2/1	3/1	1/2	2/2	3/2	4/2	1/3	2/3	3/3	1/4	2/4	3/4	
1996-1997	3	0	0	--	3	0	--	--	0	0	--	0	--	--	0
1997-1998	4	0	0	--	3	1	--	--	0	0	--	0	--	--	0
1998-1999	7	0	0	--	3	0	--	--	4	0	--	0	--	--	0
1999-2000	1	0	0	--	0	0	--	--	0	0	--	1	--	--	0
2000-2001	32	2	1	--	13	6	--	--	8	1	--	0	--	--	1
2001-2002	75	0	0	--	18	21	--	--	24	1	--	3	--	--	8
2002-2003	63	0	0	--	35	1	--	--	18	3	--	0	--	--	6
2003-2004	34	0	0	--	10	1	--	--	13	1	--	1	--	--	8
2004-2005	17	2	0	--	4	0	--	--	8	0	--	0	--	--	3
2005-2006	13	1	0	--	11	0	--	--	1	0	--	0	--	--	0
2006-2007	22	1	0	--	11	0	--	--	10	0	--	0	--	--	0

[a] Returns from the 1991 brood are progeny of wild x Big Creek stock hatchery crosses.

[b] The 1993-94 run year is the first run year in which the Hood River stock (1992 brood) would have had the potential for returning as adults to Powerdale Dam. These fish would have returned as age category 1/1 adults. None were sampled at the Powerdale Dam trap.

c Adult steelhead with a valid Hood River stock summer steelhead mark, but were classified as a winter steelhead based on run timing and visual characteristics.

1.13) Date program started (years in operation), or is expected to start.
The Hood River Production Program began in 1992.

1.14) Expected duration of program.
This is an ongoing program and there is no specified concluding date.

1.15) Watersheds targeted by program.
This program is targeting the Hood River watershed.

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.
There were four alternatives considered for the Hood River Production Program.

The **preferred alternative** was selected because it followed the Hatchery Science Review Group's guidelines, had the least potential negative impacts to listed steelhead, allowed for rebuilding of listed stocks, and provided for in-river fisheries. The preferred alternative allows for extensive monitoring and compliments ongoing habitat restoration activities in the basin.

A **segregated hatchery alternative** was rejected since it does not follow HSRG guidelines or recommendations in draft Lower Columbia River Recovery Plan. This alternative increases the risk to the wild population, from an out of basin interbreeding with wild population.

The **supplementation alternative** was rejected because recent findings in the Hood River Subbasin from Araki et al (2007) indicate a decline in the relative fitness of supplemented steelhead in the Hood River Subbasin, which may lead to a decrease the fitness of the wild population. This alternative did not include a habitat improvement component.

The **no action habitat improvement alternative** was rejected because of the lack of fishery benefits that could occur from this alternative. There was concern about the near term outlook for these seriously depressed populations and whether they may become seriously depressed before appreciable habitat improvements had provided increases in fish production.

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS.

2.1) List all ESA permits or authorizations in hand for the hatchery program.

The operation of the current collection facility operates with a 4d permit (#OR2008-4325) from NOAA Fisheries.

The Hood River Production Program is a Bonneville Power Administration funded program and is included in the NMFS Section 7 consultation biological opinion entitled: " Biological Opinion on Artificial Propagation in the Columbia River Basin – Incidental Take of listed salmon and steelhead from federal and non-federal hatchery programs that collect, rear and release unlisted fish species" (March 3, 1999).

2.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.

2.2.1) Description of ESA-listed salmonid population(s) affected by the program.

This program may affect ESA – listed populations, designated as Threatened, which include: winter steelhead (*Oncorhynchus mykiss)*, summer steelhead (*Oncorhynchus mykiss)*, coho salmon (*Oncorhynchus kisutch*) , Chinook salmon (*Oncorhynchus tshawytscha*) and bull trout (*Salvelinus confluentus).*

The wild summer steelhead adult population enumerated at Powerdale Fish Facility has ranged in size from 197 to 708 in the last five years (Table 5). All summer steelhead arriving at Powerdale Fish Facility are trapped and examined to determine origin, sex, race, and age. All wild steelhead, except those collected for broodstock for the summer steelhead supplementation program are passed upstream to spawn naturally.

The wild winter steelhead population enumerated at Powerdale Fish Facility has ranged in size from 476 to 745 in the last five years (Table 5). All winter steelhead arriving at Powerdale Fish Facility are trapped and examined to determine origin, sex, race, and age. All wild steelhead, except those collected for broodstock for the winter steelhead supplementation program are passed upstream to spawn naturally.

The wild origin coho salmon population, as determined by fin-mark, enumerated at Powerdale Fish Facility has ranged in size from 33 to 133 fish in the last five years (Table 6). All coho salmon arriving at Powerdale Fish Facility are trapped and examined to determine origin, sex, race, and age. Many of the unmarked coho salmon captured at the Powerdale fish facility have patterns of growth present on their scales that suggest hatchery origin. Olsen (2007) reports very little natural production of coho salmon in the Hood River, based upon the capture of few downstream migrant captures.

The wild fall Chinook salmon population, as determined by fin-mark, enumerated at Powerdale Fish Facility has ranged in size from 32 to 61 fish in the last five years (Table 7). In addition, many fall Chinook salmon are believed to spawn downstream of the Powerdale Fish Facility.

The wild spring Chinook salmon population, as determined by fin-mark, enumerated at Powerdale Fish Facility has ranged in size from 100 to 297 fish in the last five years (Table 8). Spring Chinook natural production is primarily limited to the West Fork of Hood River, although a minimal amount of natural production may occur in the Middle Fork Hood River.

The annual escapement of adult bull trout to Powerdale Fish Facility has ranged from 6 to 10 in the last five years (Table 9). All bull trout are passed above Powerdale Dam. Migratory bull trout captured at Powerdale, have been found to primarily home to the Middle Fork Hood River (Starcevich and Jacobs, 2007).

Table 5. The number of wild and hatchery adult steelhead counted at the Powerdale Dam adult trap, and the number collected and spawned for broodstock since the 1992 run year, and the number of spawners escaping upstream from Powerdale Dam. Data source: Olsen (2008).

	Powerdale Dam Count		Fish Passed above Dam					
Run year	**Wild fish**	**Hatchery stock 050**	**Wild fish**	**Hatchery stock 050 (*stock 13*) (*stock 024*)**	**Number of wild fish collected for brood**	**Number of wild fish spawned, by gender**	**Number of hatchery fish spawned, by gender**	**Total brood stock size, by gender**
Winter Steelhead Stock 050								
1991-92	697	0	618	*(284)*	70	40 (22m/18f)	1(1m/0f)	41 (23m/18f)
1992-93	415	0	345	*(10)*	57	37 (21m/16f)	0	37 (21m/16f)
1993-94	404	1	300	*(5)*	78	54 (28m/26f)	0	54 (28m/26f)
1994-95	206	90	161	5	42	37 (19m/18f)	0	37 (19m/18f)
1995-96	279	274	210	161	65	37 (17m/20f)	16 (12m/4f)	53 (29m/24f)
1996-97	290	636	238	252	46	32 (15m/17f)	22 (12m/10f)	54 (27m/27f)
1997-98	227	389	182	174	39	22 (11m/11f)	20 (10m/10f)	42 (21m/21f)
1998-99	298	317	255	188	41	35 (20m/15f)	27 (13m/14f)	62 (33m/29f)
1999-00	921	301	865	224	47	24 (14m/10f)	15 (5m/10f)	39 (19m/20f)
2000-01	1,015	917	877	656	130	58 (35m//23f)	4 (0m/4f)	62 (35m/27f)
2001-02	1,059	954	950	683	74	43 (23m/20f)	0	43 (23m/20f)
2002-03	745	502	654	412	66	43 (22m/21f)	1 (0m/1f)	44 (22m/22f)
2003-04	597	999	507	570	73	45 (23m/22f)	1 (1m/0f)	46 (24m/22f)
2004-05	345	481	273	246	55	23 (11m/12f)	6 (4m/2f)	29 (15m/14f)
2005-06	460	888	342	299	109	49 (29m/20f)	1 (0m/1f)	50 (29m/21f)
2006-07	476	427	423	364	54	31 (15m/16f)	3 (1m/2f)	34 (16m/18f)
Summer Steelhead Stock 050								
1992-93	490	0	489	*(1,722)*	--	--	--	--
1993-94	245	0	243	*(1,105)*	--	--	--	--
1994-95	218	0	217	*(1,623)*	--	--	--	--
1995-96	132	0	131	*(519)*	--	--	--	--
1996-97	184	0	179	*(1,307)*	--	--	--	--
1997-98	81	0	65	*(448)*	13	9(2m/7f)	0	9 (2m/7f)
1998-99	132	0	98	*(4)*	31	22(8m/14f)	3(3m/0f)	25(11m/14f)
1999-00	188	0	147	*(2)*	33	22(9m/13f)	0	22(9m/13f)
2000-01	221	7	180	*(1)*	27	23(10m/13f)	0	23(10m/13f)
2001-02	494	417	414	124	61	36(20m/16f)	1(1m/0f)	37(21m/16f)
2002-03	708	910	543	500	78	34(19m/15f)	0	34(19m/15f)
2003-04	266	656	182	205	36	27(9m/18f)	0	27(9m/18f)
2004-05	233	995	152	171	38	20(7m/13f)	0	20(7m/13f)
2005-06	206	645	170	136	13	0	0	0
2006-07	197	526	169	174	23	13(6m/7f)	1(1m/0f)	14(7m/7f)

Table 6. Jack and adult coho salmon escapements to the Powerdale Dam trap; by origin, run year, and age category. Fish of unknown origin were allocated to origin categories based on scale analysis and the ratio of fish of known origin.

Origin, run year	Total escapement	Freshwater.Total age 1.2	1.3	2.2	2.3	3.4
Natural,						
1992	23	--	--	0	23	0
1993	0	--	--	--	--	--
1994	1	--	--	0	1	0
1995	12	--	--	0	11	1
1996	7	--	--	0	7	0
1997	7	--	--	0	7	0
1998	12	--	--	0	12	0
1999	11	--	--	0	11	0
2000	9	--	--	1	8	0
2001	24	--	--	4	20	0
2002	30	--	--	3	27	0
2003	43	--	--	12	31	0
2004	133	--	--	5	128	0
2005	30	--	--	6	24	0
2006	33	--	--	4	29	0
2007	53	--	--	1	52	0
Stray hatchery,						
1992	80	0	0	13	67	--
1993	33	0	0	0	33	--
1994	55	0	0	3	52	--
1995	39	0	0	4	35	--
1996	20	0	0	1	19	--
1997	6	0	0	0	6	--
1998	47	0	0	1	46	--
1999	20	0	0	1	19	--
2000	33	1	8	4	20	--
2001	996	0	0	7	989	--
2002	67	0	1	8	58	--
2003	164	1	0	22	141	--
2004	486	0	0	18	468	--
2005	290	0	0	17	273	--
2006	333	0	0	24	309	--
2007	395	0	0	5	390	--

Table 7. Jack and adult fall Chinook salmon escapements to the Powerdale Dam trap; by origin, run year, and age category. Fish of unknown origin were allocated to origin categories based primarily on fin and maxillary mark combinations and secondarily on scale analysis, size, and the ratio of fish of known origin.

Origin,	Total	Freshwater.Total age								
Run year	escapement	1.2	1.3	1.4	1.5	1.6	2.2	2.3	2.4	2.5
Natural,										
1992	16	2	2	10	1	1	0	0	0	0
1993	6	0	1	3	2	0	0	0	0	0
1994	31	2	4	18	2	0	0	1	2	2
1995	8	1	0	1	1	0	0	1	2	2
1996	14	0	1	10	0	0	0	1	2	0
1997	28	0	7	9	0	0	0	2	7	3
1998	36	4	11	4	10	0	0	0	4	3
1999	19	1	5	4	1	0	0	0	6	2
2000	32	1	10	12	5	0	0	1	3	0
2001	29	1	11	14	0	0	0	0	3	0
2002	34	4	12	17	0	0	0	0	1	0
2003	61	4	9	36	10	0	0	0	1	1
2004	32	1	8	11	7	0	0	0	5	0
2005	45	2	11	22	5	1	0	0	0	4
2006	50	11	7	22	2	0	6	0	2	0
2007	45	3	18	14	0	0	1	1	4	4
Stray hatchery,										
1992	6	1	2	3	0	0	0	0	0	0
1993	4	0	1	2	1	0	0	0	0	0
1994	8	0	1	5	0	0	0	0	2	0
1995	4	0	0	1	0	0	0	0	3	0
1996	2	0	0	0	0	0	0	1	1	0
1997	2	0	0	1	0	0	0	0	1	0
1998	4	0	1	1	1	0	0	0	1	0
1999	0	--	--	--	--	--	--	--	--	--
2000	2	0	1	1	0	0	0	0	0	0
2001	10	0	3	1	0	0	0	0	6	0
2002	2	1	0	1	0	0	0	0	0	0
2003	3	0	0	2	1	0	0	0	0	0
2004	3	1	0	0	0	0	0	0	1	1
2005	4	0	1	3	0	0	0	0	0	0
2006	5	1	0	1	0	0	3	0	0	0
2007	0	--	--	--	--	--	--	--	--	--

Table 8. Jack and adult spring Chinook salmon escapements to the Powerdale Dam trap; by origin, stock, run year, and age category. Fish of unknown origin were allocated to origin categories based on scale analysis and the ratio of fish of known origin.

Origin stock, run year	Total escapement[a]			Freshwater.Total age									
	M	J	A	1.2	1.3	1.4	1.5	2.2	2.3	2.4	2.5	2.6	3.5
Natural,													
Hood River,[b]													
1992	0	0	35	0	1	22	1	0	0	8	3	0	0
1993	1	0	42	0	1	15	10	1	0	8	8	0	0
1994	0	1	33	1	2	14	5	0	0	5	6	1	0
1995	0	0	20	0	4	1	4	0	0	2	9	0	0
1996	1	1	96	1	4	7	0	1	0	83	1	0	1
1997	13	1	72	0	0	6	1	13	1	24	41	0	0
1998	5	1	80	0	11	14	1	5	1	16	37	1	0
1999	1	3	21	0	2	5	3	1	3	9	2	0	0
2000	3	0	66	0	6	3	0	3	0	54	3	0	0
2001	1	3	42	1	6	3	0	1	2	21	12	0	0
2002	0	2	71	1	1	8	3	0	1	41	18	0	0
2003	2	11	100	0	4	8	1	2	11	37	50	0	0
2004	7	13	131	0	1	36	6	7	13	74	11	3	0
2005	0	7	110	1	4	4	0	0	6	53	47	2	0
2006	1	4	297	0	0	10	4	1	4	245	35	3	0
2007	4	4	150	0	6	6	0	4	4	47	86	5	0
Subbasin hatchery													
Carson,													
1992	0	3	414	--	--	--	--	0	3	396	18	0	--
1993	0	15	446	--	--	--	--	--	15	213	233	0	--
1994	0	0	261	--	--	--	--	--	--	244	17	0	--
1995	0	0	36	--	--	--	--	--	--	--	35	1	--
Deschutes,													
1993	4	0	0	--	--	--	--	4	--	--	--	--	--
1994	0	5	0	--	--	--	--	*c*	5	--	--	--	--
1995	4	0	27	--	--	--	--	4	*c*	27	--	--	--
1996	0	15	2	--	--	--	--	0	15	*c*	2	--	--
1997	11	1	280	--	--	--	--	11	1	280	*c*	0	--
1998	14	2	15	--	--	--	--	14	2	12	*3*	c	--
1999	182	5	88	--	--	--	--	182	5	88	*0*	0	--
2000	918	128	20	--	--	--	--	918	128	18	*2*	0	--
2001	32	496	560	--	--	--	--	32	496	560	*0*	0	--
2002	11	24	1,029	--	--	--	--	11	24	1,009	*20*	0	--
2003	14	15	333	--	--	--	--	14	15	199	*133*	1	--
2004	168	182	152	--	--	--	--	168	182	138	*14*	0	--
2005	71	76	587	--	--	--	--	71	76	578	*8*	1	--
2006	184	35	921	--	--	--	--	184	35	854	*66*	1	--
2007	543	355	302	--	1	--	--	543	355	226	*75*	0	--

Table 8 (cont.). Jack and adult spring Chinook salmon escapements to the Powerdale Dam trap; by origin, stock, run year, and age category. Fish of unknown origin were allocated to origin categories based on scale analysis and the ratio of fish of known origin.

Origin stock, run year	Total escapement[a]			Freshwater.Total age									
	M	J	A	1.2	1.3	1.4	1.5	2.2	2.3	2.4	2.5	2.6	3.5
Stray hatchery,													
Unknown,													
1992	0	0	1	--	0	1	0	0	0	0	0	0	--
1993	0	0	2	--	0	2	0	0	0	0	0	0	--
1994	12	0	0	--	0	0	0	12	0	0	0	0	--
1995	0	3	2	--	0	0	0	0	3	1	1	0	--
1996	0	0	16	--	0	2	1	0	0	13	0	0	--
1997	0	0	6	--	0	0	0	0	0	0	6	0	--
1998	0	1	2	--	1	0	0	0	1	1	0	0	--
1999	6	0	1	--	0	0	0	6	0	0	1	0	--
2000	2	1	2	--	0	0	0	2	1	2	0	0	--
2001	52	5	25	--	0	0	0	52	5	21	4	0	--
2002	0	2	11	--	0	0	0	0	2	6	5	0	--
2003	0	4	27	--	0	0	0	0	4	21	5	1	--
2004	17	5	6	--	1	0	0	17	5	5	0	0	--
2005	4	3	17	--	0	0	0	4	3	14	3	0	--
2006	1	2	18	--	0	0	0	1	2	8	10	0	--
2007	2	3	13	--	0	0	0	2	3	10	3	0	--

[a] M = mini-jack salmon, J = jack salmon, and A = adult salmon.

[b] The natural run was developed from Deschutes and Carson stock hatchery production releases.

[c] Hatchery returns in this age category would be progeny of the 1992 brood. No hatchery fish were released into the Hood River subbasin from this brood.

Table 9. Run year specific counts of wild bull trout escaping to an adult migrant trap operated at Powerdale Dam. Counts are summarized by bi-weekly time period and counts are boldfaced for the bi-weekly period in which the median date of migration occurred during the run year.

	Total	April		May		June		July		August		September		October	
Run year	escapement	01-15	16-30	01-15	16-31	01-15	16-30	01-15	16-31	01-15	16-31	01-15	16-30	01-15	16-31
1992	6	0	0	2	**3**	1	0	0	0	0	0	0	0	0	0
1993	2	0	0	0	**1**	1	0	0	0	0	0	0	0	0	0
1994	11	0	0	1	2	**3**	3	0	2	0	0	0	0	0	0
1995	11	0	0	0	0	3	1	**2**	2	1	1	0	0	1	0
1996	18	0	0	2	0	**12**	2	1	0	0	0	0	0	1	0
1997	6	0	0	0	2	0	**2**	2	0	0	0	0	0	0	0
1998	18	0	0	0	1	6	**3**	6	1	1	0	0	0	0	0
1999	28	0	0	0	2	5	**8**	10	1	1	1	0	0	0	0
2000	27	0	0	0	10	**11**	3	2	0	0	0	1	0	0	0
2001	12	0	0	1	**8**	2	1	0	0	0	0	0	0	0	0
2002	5	0	1	1	**2**	0	0	0	1	0	0	0	0	0	0
2003	4	0	0	0	**2**	1	1	0	0	0	0	0	0	0	0
2004	10	0	1	1	**4**	2	1	0	1	0	0	0	0	0	0
2005	7	0	0	3	**2**	2	0	0	0	0	0	0	0	0	0
2006	4	0	0	0	1	**1**	2	0	0	0	0	0	0	0	0
2007	6	0	0	1	**2**	1	1	1	0	0	0	0	0	0	0

- Identify the ESA-listed population(s) that will be directly affected by the program.
LCR winter steelhead will be directly affected by the hatchery program. Up to 30 pairs of wild winter steelhead will collected at the trap and weir and utilized for broodstock.

- Identify the ESA-listed population(s) that may be incidentally affected by the program.
This program could incidentally affect the ESA- listed Hood River Bull trout, and Lower Columbia River populations of Spring and Fall Chinook salmon, summer steelhead, and coho salmon. Migrant adult bull trout could potentially be captured in the trap and weirs, since their run timing (based upon distribution at Powerdale) is similar to that of winter steelhead. Migratory bull trout have generally only been observed in the Middle Fork of the Hood River, therefore they would likely be subjected to being captured in a trap located downstream of the Middle Fork. Summer steelhead could potentially be captured also in the proposed traps, since their run timing overlaps that of winter steelhead in the Hood River. The capture of the summer steelhead will likely be minimal, as they are generally limited in their spatial distribution to the West Fork of Hood River. It would be unlikely that migratory adult spring or fall Chinook, or coho salmon would be captured in the trap and weir, due to their difference in run timing and limited period of trap operation.

Juvenile hatchery fish are released at the smolt stage, at similar times when wild origin fish are migrating to expedite migration out of the basin. It is unknown the amount of interaction that occurs between hatchery origin steelhead, and other species present in the Hood River.

2.2.2) Status of ESA-listed salmonid population(s) affected by the program.

- Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds.
The draft Lower Columbia River Recovery Plan evaluated the viability status for the ESA listed populations in the Hood River and made the following conclusions:
Hood River Coho – Very High Risk of Extinction
Hood River Spring Chinook – Very High Risk of Extinction
Hood River Summer Steelhead – Very High Risk of Extinction
Hood River Winter Steelhead –Moderate Risk of Extinction

Recent viability status assessment for Hood River bull trout populations are not available. Both the resident population, located upstream of Laurance Lake Dam, and the migratory population are critically low levels (i.e. less than 100 adults). Recent population data described by Starcevich and Jacobs (2007) suggests very small population size for both populations.

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.
See tables 1 through 11 for the most recent escapement and survival information for listed populations in the Hood River. Data is collected and compiled by the HRPP Monitoring and Evaluation Program (Olson, 2008).

Table 10. Brood year specific estimates of wild and hatchery adult summer and winter steelhead spawner escapements (i.e., above Powerdale Dam) and subbasin smolt production in the Hood River subbasin. Brood years are bold faced for those years in which race specific estimates of smolt production have been finalized[a]. Estimates of egg to smolt survival (%) are in parenthesis.

Species, brood year	Number passed above the Powerdale Dam trap[b,c]			Smolt Production[d]	Smolt production by freshwater age category			
	Males	Females	Total		Age 1	Age 2	Age 3	Age 4
Summer steelhead,								
1990	--	--	--	*e*	--	--	--	0
1991	--	--	--	*e*	--	--	469	0
1992	--	--	--	*e*	--	2,009	294	12
1993	669	1,542	2,211	1,222 (0.05)	176	635	411	0
1994	438	909	1,347	2,805 (0.22)	327	1,756	722	0
1995	752	1,088	1,840	5,536 (0.39)	333	3,910	1,293	0
1996	258	392	650	3,885 (0.63)	314	2,800	757	14
1997	557	927	1,484	8,731 (0.73)	427	5,591	2,659	54
1998	173	339	512	4,035 (0.91)	14	2,970	1,023	28
1999	25	75	100	2,000 (0.68)	211	815	964	10
2000	56	93	149	3,448 (0.96)	45	1,497	1,879	27
2001	37	142	179	3,475 (0.63)	44	2,145	1,274	12
2002	199	326	525	3,104 (0.25)	75	1,850	1,133	46
2003	346	679	1,025	*f*	335	3,217	2,416	--
2004	149	227	376	*f*	61	3,035	--	--
2005	125	194	319	*f*	28	--	--	--
2006	130	164	294	*f*	--	--	--	--
2007	127	216	343	*f*	--	--	--	--
Winter steelhead,								
1990	--	--	--	*e*	--	--	--	0
1991	--	--	--	*e*	--	--	582	0
1992	--	--	--	*e*	--	3,294	589	12
1993	129	225	354	4,397 (0.50)	1,052	2,471	874	0
1994	91	214	305	4,560 (0.56)	328	3,169	1,063	0
1995	82	84	166	7,662 (2.46)	166	6,465	1,031	0
1996	171	199	370	22,509 (3.12)	941	19,583	1,971	14
1997	189	296	485	13,840 (1.39)	305	10,471	3,009	55
1998	122	222	344	7,239 (0.94)	29	5,881	1,301	28
1999	186	255	441	3,761 (0.39)	124	2,353	1,274	10
2000	443	645	1,088	5,940 (0.25)	82	3,743	2,088	27
2001	604	908	1,512	8,578 (0.25)	441	5,353	2,773	11
2002	712	914	1,626	6,072 (0.18)	64	4,704	1,259	45
2003	384	678	1,062	*f*	721	8,405	242	--
2004	451	623	1,074	*f*	74	759	--	--
2005	222	290	512	*f*	9	--	--	--
2006	262	372	634	*f*	--	--	--	--
2007	290	494	784	*f*	--	--	--	--

[a] Race specific estimates of smolt production for the 2001-2005 broods are preliminary estimates and subject to change as adult returns from the corresponding broods near completion.

[b] Numbers have been adjusted for adults that were initially passed above Powerdale Dam and later found dead prior to spawning.

[c] Numbers include fish that were initially recycled but later passed above Powerdale Dam, either by accident or by design.

[d] Estimates of winter steelhead smolt production do not include numbers migrating from Neal Creek, a major mainstem Hood River tributary draining into a side channel opposite the mainstem migrant trap. It is estimated that up to at least 5% of the wild adult winter steelhead passed above Powerdale Dam may migrate into Neal Creek. This hypothesis is based on radio telemetry studies conducted from 1994-1996.

[e] Brood year specific estimates of subbasin smolt production cannot be made prior to the 1993 brood.

[f] Brood year specific estimates of subbasin smolt production are incomplete.

Table 11. Parameters used to estimate summer and winter steelhead egg deposition in the Hood River subbasin.

Race, brood year	Females passed above Powerdale Dam			Hatchery adult exp. rate	Pre-spawning survival	Average fecundity[a]	Subbasin egg deposition
	Wild	Hatchery	Total				
Summer steelhead,[b]							
1993	359	1,183	1,542	25%	90%	4,399	2,475,130
1994	155	754	909	25%	90%	4,432	1,294,964
1995	141	947	1,088	25%	90%	4,430	1,411,697
1996	87	305	392	25%	90%	4,377	613,054
1997	118	809	927	25%	90%	4,405	1,189,449
1998	46	293	339	25%	90%	4,391	442,316
1999	74	1	75	0%	90%	4,379	292,824
2000	92	1	93	0%	90%	4,346	361,022
2001	141	1	142	0%	90%	4,352	553,444
2002	288	38	326	0%	90%	4,310	1,264,554
2003	366	313	679	0%	90%	4,391	2,683,340
2004	131	96	227	0%	90%	4,318	882,167
2005	90	104	194	0%	90%	4,385	765,621
Winter steelhead,							
1993	221	4	225	0%	95%	4,099	876,161
1994	212	2	214	0%	95%	4,012	815,640
1995	83	1	84	0%	95%	3,905	311,619
1996	131	68	199	5%	95%	3,887	722,282
1997	144	152	296	20%	95%	3,944	995,150
1998	113	109	222	20%	95%	4,045	769,319
1999	162	93	255	0%	95%	3,958	958,826
2000	532	113	645	0%	95%	3,888	2,382,372
2001	575	333	908	0%	95%	3,961	3,416,759
2002	598	316	914	0%	95%	3,977	3,453,229
2003	431	247	678	0%	95%	4,114	2,649,827
2004	323	300	623	0%	95%	3,970	2,349,645
2005	154	136	290	0%	95%	4,116	1,133,958

[a] Average fecundity is based on a mean fecundity of 4,000, 4,400, 4,600, and 4,900 eggs per female for 1 salt, 2 salt, 3 salt, and 4 salt summer steelhead, respectively, and a mean fecundity of 3,100, 3,823, 4,770, and 4,900 eggs per female for 1 salt, 2 salt, 3 salt, and 4 salt winter steelhead, respectively. Age structure for runs of wild and hatchery steelhead was determined at Powerdale Dam.

[b] Hatchery adult summer steelhead passed above Powerdale Dam for the 1993-2001 brood years were returns of Foster stock hatchery summer steelhead released as smolts in the Hood River subbasin. Genetics data indicates this non-indigenous stock is approximately 70% less genetically fit than the wild stock. Numbers of Foster stock female hatchery summer steelhead passed above Powerdale Dam were adjusted downwards by an additional 70% to reflect the lower genetic fitness of this stock.

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.
See tables 1 through 11 for the most recent escapement and survival information for listed populations in the Hood River. Data is collected and compiled by the HRPP Monitoring and Evaluation Program (Olson, 2008).

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.
These data are summarized in Table 5. It is important note that, program goals have changed and the percentage of hatchery origin fish escaping to the spawning grounds will be significantly reduced from the data representing the previous 12 years.

2.2.3) Describe hatchery activities, including associated monitoring and evaluation and research programs that may lead to the take of listed fish in the target area, and provide estimated annual levels of take.
During trap operation period all adult migrants will be trapped, anesthetized, and bio-sampled at the Trapping facility . Fish will be tagged with individually numbered external tags, length, and scales are collected from each fish. Steelhead also have a small piece of the caudal fin removed for genetics monitoring. All fish other than those removed for broodstock or hatchery origin fish in excess of escapement needs, will be passed upstream of the trapping facility.

Fish randomly selected for the hatchery broodstock will be placed in a portable fish liberation tank and transported to the Parkdale Fish Facility. The broodstock are held in ponds specifically designed for holding adult salmon and steelhead. Brood fish are anesthetized periodically to determine the stage of sexual maturity. Mature steelhead females are air-spawned alive. After a minimum 24-hour recovery period post spawn, the females are transported for release to the mouth of Hood River. Male steelhead brood are hand stripped to fertilize eggs. The spawned males are released upstream of Powerdale to give them an opportunity to contribute to natural spawning in the subbasin.

Downstream migrant screwtraps are operated in the mainstem and major tributaries from March through October to monitor and estimate total natural and hatchery smolt emigration. These traps typically sample 5 to 10% of the downstream migrants passing a particular trap. Captured migrants are held in a live-box before they are anesthetized, bio-sampled and released. A small number of captured migrants are marked and released upstream to provide trap efficiency data.

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.
Hatchery broodstock collection occurs as one task during the operation of the proposed trapping operation. The proposed trapping facility will completely block migration, and direct all upstream migrants into a trap. As with all impediments to migration, some delay may occur as fish approach the facility and may be reluctant to enter the trap. Increased predation may occur, as fish are congregated as they approach the weir and trap. Changing flow and water conditions may affect trap efficiency. The weir and trapping facility will be designed to be as non-obtrusive as possible, but some delay may occur. The trap will operated daily to avoid any extended holding periods in the trap.

Trapping and handling devices may lead to injury of listed fish through descaling, or other injury associated with the trapping. Trapping and fish handling devices and structures will be designed to minimize the potential of injury of fish. Fish released from the facility will have a quiet holding area, where they will be able to recover before volitionally exiting the recovery area.

The proposed weir and trapping facility will build upon the 16 years of trap operations at the Powerdale Facility, and build upon the knowledge that was gained to design and operate the weir and trapping facility in the most non-obtrusive fish friendly manner.

Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.
Table 17 presents a summary of the annual number of steelhead collected for broodstock and the prespawning mortality associated with the summer and winter steelhead hatchery program. For the previous 5 year period prespawning mortality for broodstock has ranged from 0-15 annually. The trapping operation at Powerdale Dam operates under a 4d permit issued by NOAA Fisheries (OR2007-3547), in 2007 no mortalities occurred to wild winter steelhead. It is anticipated continued low levels of mortality will be associated with the proposed new trap and weir facility on the East Fork of Hood River.

- Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).
Please see the four following “Take Tables” (Tables 12-15) for winter steelhead, summer steelhead and bull trout.

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.
Weir and trap operations, physical components, or fish handling procedures will be modified immediately if any appreciable injury, delay, or mortality is observed. If take exceeds established guidelines or take authorizations, actions determined to be causing take will immediately be stopped until corrective measures are taken.

Table 12. Estimated listed salmonid take levels of by hatchery activity. Data source: ODFW, unpublished.

Listed species affected: _Summer and Winter Steelhead__ ESU/Population: Lower Columbia / Hood River____ Activity:_ Hood River Production Program – Monitoring and Evaluation _				
Location of hatchery activity:_ Downstream migrant trapping___ Dates of activity:_ Year around _ Hatchery program operator:_ Oregon Department of Fish and Wildlife				
Type of Take	**Annual Take of Listed Fish By Life Stage (*Number of Fish*)**			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)	0	<10,000	NA	NA
Collect for transport b)	0	0	NA	NA
Capture, handle, and release c)	<500	<10,000	NA	NA
Capture, handle, tag/mark/tissue sample, and release d)	0	0	NA	NA
Removal (e.g. broodstock) e)	-	-	NA	NA
Intentional lethal take f)	-	100 (EPA)	NA	NA
Unintentional lethal take g)	<50	< 120	NA	NA
Other Take (specify) h)	-	0	NA	NA

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migration delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.

Table 13. Estimated listed salmonid take levels of by hatchery activity. Data source: ODFW, unpublished.

Listed species affected: _Winter Steelhead__ ESU/Population: Lower Columbia / Hood River____ Activity:_ Hood River Production Program – Supplementation of wild population_				
Location of hatchery activity:_ Powerdale Fish Facility / Parkdale Fish Facility___ Dates of activity:_ Year around _ Hatchery program operator:_ Oregon Department of Fish and Wildlife / Confederated Tribes of Warm Springs Reservation of Oregon_				
Type of Take	**Annual Take of Listed Fish By Life Stage (*<u>Number of Fish</u>*)**			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)	<85,000	70,000	1,000	0
Collect for transport b)	<85,000	65,000	<100	<20
Capture, handle, and release c)	-	-	-	NA
Capture, handle, tag/mark/tissue sample, and release d)	-	65,000	1,000	NA
Removal (e.g. broodstock) e)	-	-	<100	NA
Intentional lethal take f)	-	0	0	NA
Unintentional lethal take g)	-	0	<20	NA
Other Take (specify) h)	<15,000 mortality	5,000 mortality	0	NA

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migration delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.

Table 14. Estimated listed salmonid take levels of by hatchery activity. Data source: ODFW, unpublished.

Listed species affected: _Summer Steelhead_ ESU/Population:_ Lower Columbia / Hood River__ Activity:_ Hood River Production Program_- Supplementation of the wild population_				
Location of hatchery activity: Powerdale Fish Facility / Powerdale Fish Facility______ Dates of activity:__ Year around______ Hatchery program operator:_ Oregon Department of Fish and Wildlife / Confederated Tribes of Warm Springs reservation of Oregon_				
Type of Take	**Annual Take of Listed Fish By Life Stage (*Number of Fish*)**			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)	0	10,000	<500	0
Collect for transport b)	52,384	0	<50	0
Capture, handle, and release c)	0	0	<450	0
Capture, handle, tag/mark/tissue sample, and release d)	0	0	<450	0
Removal (e.g. broodstock) e)	0	0	<50	0
Intentional lethal take f)	0	0	0	0
Unintentional lethal take g)	0	0	<10	0
Other Take (specify) h)	0	0	0	0

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migration delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.

Table 15. Estimated listed salmonid take levels of by hatchery activity. Data source: ODFW, unpublished.

Listed species affected: Bull Trout____ ESU/Population:_ Lower Deschutes / Hood River Activity:__ Hood River Production Program_				
Location of hatchery activity:_ Powerdale Fish Facility_ Dates of activity: _May through October___ Hatchery program operator:_Oregon Department of Fish and Wildlife_				
	Annual Take of Listed Fish By Life Stage *(Number of Fish)*			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)	0	0	0	0
Collect for transport b)	0	0	0	0
Capture, handle, and release c)	0	0	0	0
Capture, handle, tag/mark/tissue sample, and release d)	0	0	28	0
Removal (e.g. broodstock) e)	0	0	0	0
Intentional lethal take f)	0	0	0	0
Unintentional lethal take g)	0	0	0	0
Other Take (specify) h)	0	0	0	0

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migration delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

The hatchery program will follow guidelines developed by HSRG, Draft Lower Columbia River Recovery Plan, Hood River Subbasin Plan, and Hood River Master Plan.

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

This program operates under the Hood River Master Plan, Hood River/Pelton Ladder Master Agreement, Hood River EIS and the Salmon and Steelhead Production Plan for the Hood River Subbasin (System Plan). The program is included in the *US vs. Oregon* Hatchery Production tables (2007) and is consistent with the1855 Treaty with the Tribes of Middle Oregon (12 stat. 963).

3.3) Relationship to harvest objectives.

Program fish contribute to tribal and sport fisheries both in basin and outside of the basin. Hood River sport steelhead fisheries have been restricted to a fin-clipped hatchery fish harvest since 1992. While some catch and release hooking mortality likely occurs on wild steelhead, the exact rate remains unknown but is believed to be low during winter steelhead fisheries on the Hood River. Winter steelhead fisheries generally occur at times when water temperatures are cool, which can reduce hooking mortality associated with catch and release. The harvest objective described in the Hood River Master Plan identifies 876 hatchery origin winter steelhead to be harvested in the Hood River by tribal and sport fisheries.

3.3.1) Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.

In-river yearly sport harvest of Hood River hatchery winter steelhead has ranged from 170 to 841 (Table 16). Harvest also occurs in Lower Mainstem Columbia River Sport fisheries, however, harvest rate is assumed to be minimal in these fisheries. Harvest also occurs in tribal Zone 6 commercial, ceremonial, and subsistence fisheries, although, specific harvest rates on Hood River fish are unknown.

Table 16. Estimates of winter steelhead harvest[a] in non-tribal fisheries located from River Mile (RM) 0 to RM 4.5 in the mainstem Hood River, by run year. Estimates of the number released are in parenthesis. Run years are bold faced for those years in which estimates of harvest are complete.

		Harvests[b]		
Run year	Period[c]	Wild[d,e]	Subbasin hatchery	Stray hatchery
1995-1996g	1 Jan - 30 Jun	0 (267)	314 (170)	12 (0)
1996-1997	1 Dec - 30 Jun	0 (205)	319 (229)	11 (0)
1997-1998	1 Nov - 30 Jun	5 (220)	231 (103)	0 (0)
1998-1999	16 Nov - 30 Jun	0 (225)	172 (126)	0 (0)
1999-2000	16 Nov - 30 Jun	0 (339)	217 (23)	6 (0)
2000-2001	16 Jan - 30 Jun	0 (330)	351 (61)	0 (0)
2001-2002	1 Nov - 30 Jun	5 (1,328)	841 (156)	3 (10)
2002-2003	1 Nov - 30 Jun	5 (833)	411 (147)	0 (0)
2003-2004	16 Nov - 30 Jun	0 (854)	475 (266)	3 (5)
2004-2005	16 Nov - 30 Jun	0 (306)	182 (86)	6 (0)
2005-2006	16 Sep - 30 Jun	2 (477)	457 (208)	12 (0)
2006-2007	16 Oct - 30 Jun	0 (220)	170 (98)	19 (0)

[a] Bi-weekly and annual estimates of harvest, and 95% confidence limits, are presented by calendar year in Olsen and French (1996), Olsen and French (1999), Olsen and French (2000), Olsen (2003), Olsen (2004), Olsen (2006a), Olsen (2006b), Olsen (2007), and Olsen (2008).

[b] Estimates of harvest include fish recycled below Powerdale Dam.

[c] The sampling period encompasses two calendar years and extends from the first bi-weekly period in which fish are first sampled in the first calendar year of the creel to a defined ending date in the second calendar year of 30 June.

[d] Estimates of released wild winter steelhead may include numbers expanded from wild adult steelhead mis-identified with respect to race.

[e] Estimates of caught and released wild winter steelhead may include Hood River stock maxillary clipped only hatchery summer steelhead that were reported by anglers as wild winter steelhead. Maxillary clipped only Hood River stock hatchery summer steelhead began returning to the Hood River subbasin beginning with the 2000-2001 run year.

[f] Estimates beginning with the 2000-2001 run year may be based on adult steelhead which had a valid Hood River stock hatchery summer steelhead mark, but were classified as a stray hatchery winter steelhead based on the standard criteria used at the adult collection facility located at Powerdale Dam.

[g] Incomplete run year. Creel was not implemented until 1 January, 1996.

3.4) Relationship to habitat protection and recovery strategies.

Several probable causes contributed to the depressed status of the Hood subbasin steelhead populations including: 1) adult fish passage problems (marginal and intermittent passage at the Edward Hines Dam, low flow below Powerdale Dam, poor fish ladder attraction, Dee Irrigation Diversion blockage, Punchbowl Falls barrier); 2) lack of, or in-efficient juvenile fish protection at irrigation diversions East Fork Irrigation Diversion, Farmers Irrigation Diversion, Dee Irrigation Diversion, PacifiCorp diversion at Powerdale Dam); 3) degradation of suitable habitat (gravel and woody debris); and 4) unfavorable natural conditions in the Hood River subbasin (glacial silt, glacial outburst floods such as the Middle Fork 2006 event) 5) water withdrawals (irrigation and hydropower).

Habitat conditions in Hood River have changed considerably from those described in the previous paragraph. The Edward Hines Dam was removed in the mid-1960's, fish ladders have been built or improved at Powerdale Fish Facility, Punchbowl Falls and Moving Falls. Most unscreened, or improperly screened diversions, are now screened to criteria. Interim operating conditions, and lack of power generating capabilities at Powerdale Dam have improved and passage, and increased flow downstream of the dam. Decommissioning and removal of Powerdale Dam in 2010 will significantly improve conditions for fish in the lower Hood River.

Agencies, irrigation districts, and concerned public cooperatively work together through the Hood River Watershed Group to coordinate restoration efforts and funding. A holistic watershed approach is under implementation with specific projects identified in the Hood River Action Plan (Stamphli, 2008). The habitat restoration component of the HRPP is actively engaged in habitat restoration activities that address limiting factors to anadromous salmonid production. Current and future activities include fish screening, flow restoration through irrigation ditch piping, fish passage, and instream/riparian restoration. Approximately $700,000 is expended annually by the CTWSRO/BPA for these habitat restoration activities. Other significant funding is provided by OWEB, ODFW, and the USFS.

3.5) Ecological interactions.

The steelhead production project could potentially negatively impact summer steelhead, coho salmon, fall Chinook salmon, spring Chinook salmon, and bull trout because of increased number of juveniles created by the hatchery program. Competition and predation with these listed species is possible if released fish residualize in the Hood River and compete or prey on other species. Increased predation from predators is also possible as the increased numbers could attract additional predators. The potential residualism is addressed by rearing all fish to the smolt stage and releasing when they are most ready to migrate out the basin. The acclimation program, along with a volitional release, allows for fish with strong migratory tendencies to leave the acclimation ponds. Fish that do not voluntarily leave the acclimation, are transported to the lower Hood River further reducing the risk of residuals in the Hood River.

Collecting winter broodstock in the East and Middle Forks of the Hood River will further prevent the inadvertent mixing of the summer and winter run due the spatial segregation of the two ecotypes in the Hood River. Additionally microsatellite nuclear DNA discrimination will be used to further prevent the mixing of the two ecotypes for all hatchery-reared steelhead smolts coupled with the transportation of non-migrants to the lower Hood River, below Powerdale Dam (Matala and Ardren, 2007)

All listed species will benefit from the habitat improvement projects (i.e. in-stream and streamside habitat restoration, fish passage, and improved flows) that are an integral part of the Hood River Production Program.

SECTION 4. WATER SOURCE

4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

The Parkdale Fish Facility has three sources of water available for all or portions of the facility operation. Rogers Spring Creek provides high quality water with a constant temperature of 38 to 40°F. Middle Fork Hood River provides a seasonally variable temperature water that ranges from the low 30’s to the mid-50’s. A small well provides supplemental water at a temperature of 46 to 48°F. The spring and river water sources can be used independently or they can be mixed to achieve a desired temperature regime or specific imprinting for acclimating smolts.

The Middle Fork water source is the same water source that the naturally spawning salmonids utilize in this portion of the Hood River system. The Rogers Spring Creek is a tributary to the lower Middle Fork Hood River and so naturally mixes with the Middle Fork water.

Oak Springs Fish Hatchery, as the name implies, has a large series of natural springs that provide a large volume of high quality spring water at a constant temperature of 53°F. This water is chilled to 43°F for use in the hatchery incubators. This hatchery has been in operation for more than fifty years and has never experienced any water quality or quantity deficiencies. The water quality is monitored at this station.

4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.

The Parkdale Fish Facility uses a relatively small amount of water for a small number of fish. The water is used in a once through scenario and there is no identified need for any effluent treatment. All three water sources originate at locations that are inaccessible to anadromy.

The Oak Springs Fish Hatchery water supply is a series of large springs located well up the near vertical Deschutes River canyon wall. The hatchery utilizes 50 cfs in their supply system, which is secured with a State of Oregon water right. The springs are non-fish bearing and the intake is fitted with coarse screen for debris control only. Two effluent settling ponds with capacities of 9,600 and 9,000 cubic feet are used to meet NPDES permit 0300J water quality standards before water is discharged into the Deschutes River.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Winter steelhead will be collected at a seasonally operated (January 15- May 30) floating weir and trap located in the East Fork Hood River approximately 200 meters downstream from the confluence of the Middle Fork of Hood River. An appropriate sized trap live box will be designed that will safely accommodate expected catch. Information and data collected from the ongoing trap operations at the Powerdale Fish Trapping Facility will be utilized to design and construct the trap and associated live box in the most fish design. Alternative trap sites will be evaluated near the mouths of East and Middle Forks of Hood River, if a the single weir and trap site is not feasible. Final design and location of the trap and weir will be completed in the summer of 2009. Weir and traps will be designed to meet NOAA Fisheries and ODFW fish trapping criteria. Traps will be checked daily, and broodstock will be randomly collected throughout the temporal distribution of the winter steelhead run.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

Broodstock will be transported daily, upon collection, to the Parkdale Fish Facility using a 500 gallon fiberglass tank with an aeration system mounted on a one ton flatbed pickup. Up to 10 fish can be hauled safely per trip.

5.3) Broodstock holding and spawning facilities.

All of the broodstock used at Parkdale Fish Facility are delivered from the Powerdale Fish Facility and are held in one of the two 8x40 foot concrete holding ponds. Water depth can be adjusted for desired depths. Under normal operation the ponds are four feet deep. These brood ponds are supplied with water from either the Middle Fork Hood River or Rogers Creek. The water is delivered underground and is gravity fed. Water can be adjusted for desired flows, but are normally set for 400 gpm for each pond. Each pond can be supplied with water from either source or receive a mixture of the two sources. Pond water temperatures and depths are continually monitored by the Global

Monitoring System (GMS). Flow meters monitor pond flows. The upper end of each pond is fitted with slotted aluminum screen systems. The spray bars deliver approximately 50 gpm to each pond and can utilize water from either source. The adult ponds are painted camouflage and shade cloth is attached to the perimeter railing. Adult salmon and steelhead are held in these ponds until they are spawned and/or released back to the Hood River. No adverse critical habitat is lost between the intake diversion and the discharge back to Rogers Spring.

The spawning building at Parkdale Fish Facility is located in close proximity to the adult holding ponds. The spawning building is approximately 18x18 feet. It is constructed of split face concrete block and has a metal roof. The building has electrical supply and is plumbed with hot and cold water. All the necessary supplies for spawning are located in this building. Emergency pumps to operate adult pond spray bars are located in this building. Adult broodstock are handled and sorted prior to spawning in this building. A floor drain diverts spawning refuse to the 8,000 gallon fish waste tank (FWT).

5.4) Incubation facilities.

The incubation room at the Parkdale Fish Facility is approximately 16x16 feet. It is a continuation of the spawning building and is constructed exactly as the spawning building. The building receives the same water sources as the adult holding ponds. Gravity fed water from the Rogers Spring or Middle Fork Hood River supplies the Marisource vertical stack incubators. There are presently four stacks of incubators with eight trays per stack. Booster pumps and a GMS sensitive head box are plumbed to the incubators. An additional aluminum head box and four more stocks of Marisource vertical incubators have been acquired for possible future incubation needs. Discharge water from the incubators is returned back to Rogers Creek. The two floor drains are plumbed to the 8,000 gallon FWT. Green eggs can be incubated and hatched and held to the swim-up stage.

At Oak Springs Fish Hatchery the steelhead eggs are incubated in Marisource isolation type incubators. The water supply to the incubator can be chilled to adjust the incubation period.

5.5) Rearing facilities.

Steelhead rearing at Oak Springs Fish Hatchery begins in fiberglass “Canadian” style containers that range in length from 9 to 21 feet. When the fish reach 200 per pound they are transferred to 30 foot diameter circular concrete ponds. The final rearing occurs in 46x8 foot concrete ponds.

5.6) Acclimation/release facilities.

Acclimation and release sites were chosen in the Middle and East Forks of the Hood River.. These sites were picked because of their close proximity to prime spawning and rearing habitat.

The Middle Fork Hood River site at Parkdale Fish Facility has two 8x80 foot acclimation ponds, which are typically adjusted to a depth of four feet. The water source is the same as that for the adult holding ponds. Water is delivered by gravity through underground pipes. Either Middle Fork or Rogers Spring water or a combination of the two can be used for acclimation. Water depths and temperatures are constantly monitored by the GMS, flow meters also monitor water flows. Maximum flows are set at 750 gpm per pond. The upper ends of the ponds are fitted with slotted aluminum screens. The lower ends of the ponds are fitted with double slotted screens; slotted dam board channels control the depth of the ponds. Both ponds are painted camouflage. Typically, winter steelhead smolts are held here during acclimation for several weeks prior to a volitional release.

Acclimation of winter steelhead smolts on the East Fork Hood River occurs at the East Fork Irrigation District's sand trap located at RM 6.0. The sand trap consists of a series of five rectangular concrete ponds, each with a shallow and deep end, designed to capture glacial sand that washes down the canal after water is diverted from the East Fork. With East Fork Irrigation District approval, one of the ponds was modified with screens and stop logs so fish could be held and acclimated. The stop logs provide the same type of release as described at Parkdale Fish Facility.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.
There have been no significant losses of steelhead thus far in this supplementation program.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.
The Parkdale Fish Facility and Oak Springs Fish Hatchery are staffed full time. Both facilities have sophisticated alarm systems that alert staff to problems with water supply.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to wild fish of the same species/population.

6.1) Source.
The Hood River winter steelhead supplementation project, contained within the Hood River Production Program, began with an angler brood collection program for wild winter steelhead from the lower mainstem Hood River in 1991. Beginning in 1992 all Hood River winter steelhead brood have been collected from wild Hood River stock captured in the Powerdale Fish Facility (RM 4.0).

Beginning in January 2011, wild winter steelhead broodstock, as identified by lack of a fin-mark and DNA scale analysis, will be collected at the East Fork Hood River trap and weir. Hood River winter steelhead are in the Lower Columbia River Ecological Significant Unit and listed as a threatened species under the ESA. The proposed annual collection goal is 60 fish. It is anticipated that fewer fish will actually be utilized as broodstock to meet production needs, but that additional fish may be collected that do not meet phenotypic and genotypic collection criteria. Rapid read DNA genetic sequencing will be utilized to determine genetic compatibility for inclusion into broodstock. Fish collected for broodstock, which do not meet both phenotypic and genotypic criteria will be released back to the Hood River within 14 days after collection.

6.2) Supporting information.

6.2.1) History.

Winter steelhead stock 050 was founded in 1991 by collecting wild Hood River winter steelhead. The first collection effort in 1991 was done by angling and was not very successful. The first effective year of broodstock collection was in 1992 and used the Powerdale Fish Facility, located at Powerdale Dam, Hood River (RM 4.0). Each year since 1992, the broodstock has been sub-sampled from throughout the Hood River wild winter steelhead run , which passes the dam en route to the natural production areas above the dam. Most of the Hood River winter steelhead population spawns in this upper basin production area. All of the fish passing the dam are collected in the trap. Candidates for winter steelhead stock 050 are selected randomly throughout the run. The broodstock consisted of 100% wild fish from 1991 to 1995, and has included a proportion of returning hatchery fish stock 050 since 1996. The number of wild and hatchery winter steelhead counted at Powerdale Fish Facility and the number of fish taken for brood, by gender, since the founding of the stock is provided in Table 5.

6.2.2) Annual size.

Hood River Production Program protocols specify that the fish collected for hatchery broodstock will not exceed 25% of the natural population, with less than 60 adults collected for broodstock. If wild spawner escapement is projected to not be robust enough to remain below the 25% broodstock take requirement, the project will incorporate some returning hatchery fish into the broodstock following HSRG guidelines, or will be discontinued until wild run size recovers. Based upon recent fecundity estimates of wild winter Hood River steelhead approximately 20 females will be required for the needed egg take. Approximately 70,000 eggs will need to be collected to meet program goals of producing 50,000 yearling smolts for release. Table 5 summarizes the Hood River summer and winter steelhead broodstock collection to date. This table also summarizes the sex ratio of the fish spawned, by brood year.

6.2.3) Past and proposed level of natural fish in broodstock.

The number taken for the broodstock, and the actual spawning population sizes are provided in Table 5. For the 1996 through 1999 brood years, the winter steelhead broodstock has averaged 58.6% wild fish. From 1999 brood year through the present, the winter brood has consisted of 100% wild fish. Oregon Department of Fish and Wildlife and NOAA Fisheries policy limits the take for broodstock to 25% or less of a wild population in an effort to protect wild populations from the impact of removing fish for the purposes of developing and maintaining a hatchery broodstock. The annual wild winter steelhead broodstock take has ranged from 54 to 109 over the last five year period. Actual numbers of wild fish utilized for broodstock during that same period ranged from 31-49 fish (Table 17). Fish collected for broodstock, but not utilized due to failed broodstock selection criteria, were released in the Powerdale Dam Forebay. Recent findings by Araki et al. (2007) suggest that first generation progeny from wild hatchery parents have the highest fitness in the Hood River, and would thus have least potential negative affects on wild Hood River Fish. The project will strive to collect 100% wild winter steelhead broodstock when natural run size allows. If wild spawner escapement is projected to not be robust enough to remain below the 25% broodstock take requirement, the project will incorporate some returning hatchery fish into the broodstock following HSRG guidelines, or will be discontinued until wild run size recovers.

6.2.4) Genetic or ecological differences.
Age structure of returning hatchery steelhead (stock 050) will be different from returning naturally produced steelhead. All hatchery steelhead smolts are released as yearlings, while wild steelhead smolts have a diverse life history with up to four fresh water patterns. Wild steelhead smolts range from 1-year to 4-year smolts, but are predominately 2-year smolts and secondarily 3-year smolts. To date there is no indication that ocean age, 1 to 4 years, is different for hatchery and wild Hood River steelhead. See table 2 for age structure patterns of wild hatchery origin Hood River winter steelhead. The difference in freshwater age between hatchery and wild steelhead results in a different total age when returning to spawn. Yearling hatchery smolts are significantly larger in size than wild smolts at the same age. Adult size is similar between hatchery and wild origin fish.

All returning Hood River hatchery and wild origin winter steelhead that have been captured at the Powerdale Fish Trapping Facility from 1991 to present have been genotyped (Araki and Blouin, 2006).

6.2.5) Reasons for choosing.
Wild Hood River winter steelhead were selected for the hatchery broodstock because they are the best representation of the wild indigenous winter steelhead populations in the Hood River subbasin and believed to have the least deleterious affects on the fitness of the wild population if wild and hatchery fish interbreed (Araki et. al, , 2007).

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.
Wild origin broodstock will be collected randomly to not intentionally select any particular trait, however selection will be stratified from throughout the entire temporal distribution of the run to help insure that all genetic attributes are represented in the hatchery stock from throughout the entire run timing distribution and they are genetically similar to the natural stock. Fish will be spawned as they mature, with one male and one female per spawning.

To ensure that only wild origin Hood River winter steelhead are used for broodstock, scale growth patterns will be analyzed to ensure wild growth characteristic from fish selected for broodstock prior to spawning. Genotyping using microsattelite DNA will also be utilized to ensure that fish are most likely from Hood River wild winter steelhead origin ecotype. Fish collected for broodstock not meeting these criteria, will be returned to the river prior to spawning.

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

Returning adult winter steelhead will be collected for the hatchery broodstock.

7.2) Collection or sampling design.

The broodstock collection will be located below the confluents of the Middle Fork Hood River and the East Fork Hood. This location is downstream of most winter steelhead natural spawning areas. All of the fish entering the upper basin will be captured in the trap, allowing for precise bio sampling from the available fish. Broodstock will be randomly selected throughout the winter steelhead run. Wild broodstock collection in the Hood Basin is limited by the small wild population. Due to this concern, the limit on the take of wild fish for broodstock needs to be closely monitored. Collection of low numbers of broodstock have the risk of introducing random deviation from the phenotypic distributions of wild fish.

There are two options for designing a broodstock selection regime to avoid bias when all possible fish are available for selection. One alternative is to select the broodstock at random from the total available fish. However, when the sample size is quite small, as in the case of the Hood River programs, this protocol may produce by random chance a sample with a skewed distribution for any particular trait. For example, if a broodstock of only 36 fish are taken from a wild population of 300 fish that has a run timing across three months, by chance all 36 fish could be selected from the first half of the run. While this is a random outcome, the sample is not representative of the distribution from which it was drawn. A second way to select the broodstock is to stratify the small sample across the known distribution of one or more traits, such as run timing. This approach is not random but it produces a sample with a character distribution for the stratified trait that is more similar to that of the wild population.

Broodstock in the Hood are selected using both methods. The selection is stratified across run timing, but is random according to all other possible phenotypes. Stratification across run time is done by estimating the wild population size in advance, selecting a maximum broodstock size within the limit on take of wild fish, and then distributing the take evenly across the run. In a winter steelhead run, typically every N^{th} male and female passing Powerdale Fish Facility are selected and collected for the brood, although the actual take varies from year to year. If hatchery fish are used in the broodstock, they will be sampled according to the same protocol for that year. Run timing information for summer and winter steelhead counted at Powerdale Fish Facility are presented in Tables 17 and 18. The number of wild winter steelhead collected for broodstock, their disposition, and the number spawned is presented in Table 19.

Table 17. Bimonthly counts of adult summer steelhead captured at the Powerdale Dam trap by origin and run year. Bimonthly counts are reported for March through December. The bimonthly count in which the median date of migration occurred is boldfaced for completed run years (i.e., the 1992-1993 through 2006-2007 run years). Data source: Olsen (2008).

Origin, stock,	February		March		April		May		June		July		August		September		October		November		December			
run year	01-15	16-29	01-15	16-31	01-15	16-30	01-15	16-31	01-15	16-30	01-15	16-31	01-15	16-31	01-15	16-30	01-15	16-31	01-15	16-30	01-15	16-31	Jan-May	Total
Wild, Hood River,																								
1992-1993	0	0	0	1	12	6	7	21	31	68	49	**49**	37	18	17	55	25	24	38	12	2	1	4	477
1993-1994	0	0	0	1	10	5	8	21	13	21	25	**26**	14	10	8	5	11	8	1	1	10	0	30	228
1994-1995	0	0	0	1	3	4	9	7	22	25	**32**	33	11	1	4	8	2	7	5	0	0	0	9	183
1995-1996[a]	0	0	0	0	0	0	2	1	4	6	37	**19**	16	2	5	5	2	8	0	8	0	0	7	122
1996-1997	0	0	0	0	0	1	3	3	12	17	32	**32**	14	6	6	5	16	10	7	0	0	1	5	170
1997-1998	0	0	0	0	0	0	1	2	1	4	6	6	**14**	2	4	7	9	2	8	0	0	0	1	67
1998-1999	0	0	0	0	0	1	3	2	5	13	15	17	**7**	5	5	7	7	4	3	13	1	0	11	119
1999-2000	0	0	0	0	1	0	1	5	7	6	19	28	11	5	0	**8**	8	3	35	8	8	0	24	177
2000-2001[b]	0	0	0	0	1	3	2	12	13	39	20	**22**	14	9	10	23	3	26	1	0	0	0	7	205
2001-2002	0	0	1	0	8	19	10	42	37	27	51	35	**23**	16	11	11	15	48	51	28	7	6	34	480
2002-2003	0	0	0	1	3	6	10	19	34	38	74	61	27	18	15	**23**	42	15	28	65	0	13	159	651
2003-2004	0	0	1	3	5	4	4	15	31	9	24	21	**9**	12	16	23	10	32	2	8	2	5	8	244
2004-2005	0	0	1	0	0	1	6	2	8	19	15	17	14	12	**12**	25	21	23	5	3	2	5	14	205
2005-2006	0	0	0	1	3	5	2	7	6	12	19	20	6	5	4	**10**	42	27	11	3	0	0	13	196
2006-2007[c]	0	0	0	0	2	0	2	4	3	15	18	16	11	17	**21**	5	16	27	6	0	1	0	26	190
2007-2008[d]	0	0	0	3	2	0	0	3	8	1	15	10	6	16	23	8	25	12	11	4	2	1	10	160
Subbasin hatchery,																								
Foster,																								
1992-1993	0	0	0	8	48	82	131	190	136	**279**	254	220	136	28	26	55	24	10	15	4	1	4	20	1,671
1993-1994	0	0	0	1	13	38	83	120	75	151	**188**	166	113	33	23	8	16	10	0	1	11	0	19	1,069
1994-1995	0	0	0	4	13	79	125	165	268	**297**	316	164	26	10	13	17	17	12	12	4	0	0	20	1,562
1995-1996[a]	0	0	0	0	4	0	5	12	30	31	**210**	101	52	13	15	4	9	4	1	10	0	2	6	509
1996-1997	0	0	0	2	39	29	122	152	**304**	189	257	120	24	15	3	3	9	7	4	0	0	1	8	1,288
1997-1998	0	0	0	0	0	11	36	59	23	66	**109**	68	112	21	17	25	9	3	2	0	0	0	3	564
1998-1999	0	0	0	1	2	21	20	25	88	60	**111**	103	16	12	19	15	5	7	2	10	0	0	7	524
1999-2000	0	0	0	0	3	9	2	31	20	64	75	**121**	65	20	3	3	7	2	10	1	3	0	21	460
2000-2001[b]	0	0	2	11	43	68	77	179	155	**228**	170	111	41	23	19	8	0	9	2	0	0	0	5	1,151
2001-2002	0	0	3	22	48	238	192	323	**226**	205	162	101	46	15	3	6	14	31	27	51	3	6	79	1,801
2002-2003	0	0	0	5	21	43	115	142	272	**296**	296	152	47	26	15	5	27	7	5	15	0	8	68	1,565
2003-2004	0	0	1	10	54	95	113	171	**224**	169	137	83	25	17	15	27	29	14	2	2	1	2	33	1,224
2004-2005	0	0	0	3	37	92	188	161	286	**383**	215	125	40	28	17	37	22	9	9	4	1	4	37	1,698

Table 17 (cont.). Bimonthly counts of adult summer steelhead captured at the Powerdale Dam trap by origin and run year. Bimonthly counts are reported for March through December. The bimonthly count in which the median date of migration occurred is boldfaced for completed run years (i.e., the 1992-1993 through 2006-2007 run years). Data source: Olsen (2008).

Origin, stock,	February		March		April		May		June		July		August		September		October		November		December			
run year	01-15	16-29	01-15	16-31	01-15	16-30	01-15	16-31	01-15	16-30	01-15	16-31	01-15	16-31	01-15	16-30	01-15	16-31	01-15	16-30	01-15	16-31	Jan-May	Total
2005-2006	0	0	0	1	6	35	49	44	84	**99**	74	42	18	6	7	5	23	14	3	0	0	0	34	544
2006-2007[c]	0	0	0	1	2	4	15	42	26	102	**94**	43	12	9	8	2	3	8	0	0	1	1	52	425
2007-2008[d]	0	0	0	1	6	8	15	24	60	43	74	15	8	10	2	1	7	2	4	1	3	1	1	286
Hood River,																								
2000-2001[b]	0	0	0	0	0	0	0	0	0	0	0	0	1	1	**3**	1	0	1	0	0	0	0	0	7
2001-2002	0	0	0	0	0	3	2	10	16	17	30	27	32	9	8	28	**33**	63	72	25	0	2	27	404
2002-2003	0	0	0	0	0	3	10	11	36	64	109	90	46	52	**43**	41	75	20	51	114	2	27	111	905
2003-2004	0	1	1	0	1	1	10	14	49	38	79	49	22	17	25	**52**	68	61	5	16	11	9	111	640
2004-2005	0	0	0	0	0	4	10	5	33	140	122	86	50	40	**39**	145	99	91	37	13	7	23	42	986
2005-2006	0	0	0	0	1	2	14	19	35	53	77	52	23	28	**25**	25	137	68	17	2	0	0	57	635
2006-2007[c]	0	0	0	0	0	0	3	4	6	26	59	61	48	38	**63**	50	63	70	4	0	2	2	22	521
2007-2008[d]	0	0	0	0	1	2	1	4	17	14	83	49	24	47	53	42	76	27	23	14	0	3	0	480
Hood River (Unknown),[e]																								
2001-2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**5**	2	0	0	0	2	10
2002-2003	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	4	**75**	83
2003-2004	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	**2**	4	1	0	10
2004-2005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	**3**	0	0	0	1	7
2005-2006	0	0	0	0	2	0	0	0	0	0	1	1	1	0	2	7	**11**	13	6	1	1	0	3	49
2006-2007[c]	0	0	0	0	1	1	1	0	0	0	3	0	0	1	8	3	12	**17**	2	0	1	0	14	64
2007-2008[d]	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	9	3	7	7	0	0	0	29
Stray hatchery,																								
Unknown,																								
1992-1993	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**4**	5
1993-1994	0	0	0	0	0	1	0	0	2	2	**3**	0	0	2	0	0	1	0	0	0	1	0	1	13
1994-1995	0	0	0	0	0	0	0	**2**	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	4
1995-1996[a]	0	0	0	0	0	0	0	0	0	1	0	**2**	0	0	0	0	0	0	1	1	0	0	0	5
1996-1997	0	0	0	0	0	0	0	0	2	1	2	0	0	2	0	0	**1**	4	1	0	0	0	2	15
1997-1998	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**2**	2	1	0	0	0	0	6
1998-1999	0	0	0	1	0	0	0	0	0	0	0	1	0	0	2	**5**	1	0	0	0	0	0	1	11
1999-2000	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	1	0	0	0	2
2000-2001[b]	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	**5**	0	2	2	0	0	0	0	11
2001-2002	0	0	0	0	0	0	0	0	3	3	1	1	1	0	1	1	0	**10**	6	1	0	1	0	29

Table 17 (cont.). Bimonthly counts of adult summer steelhead captured at the Powerdale Dam trap by origin and run year. Bimonthly counts are reported for March through December. The bimonthly count in which the median date of migration occurred is boldfaced for completed run years (i.e., the 1992-1993 through 2006-2007 run years). Data source: Olsen (2008).

Origin, stock,	February		March		April		May		June		July		August		September		October		November		December			
run year	01-15	16-29	01-15	16-31	01-15	16-30	01-15	16-31	01-15	16-30	01-15	16-31	01-15	16-31	01-15	16-30	01-15	16-31	01-15	16-30	01-15	16-31	Jan-May	Total
2002-2003	0	0	0	0	0	0	0	0	1	0	1	4	0	0	1	2	2	0	**3**	3	0	2	5	24
2003-2004	0	0	0	0	1	0	2	**3**	3	0	0	1	1	0	0	0	0	1	0	0	0	0	0	12
2004-2005	0	0	0	0	1	1	0	1	1	1	2	1	2	0	0	1	1	**1**	0	0	1	0	12	26
2005-2006	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	1	**7**	1	0	0	0	0	0	12
2006-2007[c]	0	0	0	0	0	0	0	1	2	0	2	1	1	0	0	0	0	0	0	0	0	0	**32**	39
2007-2008[d]	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	3
Unknown,																								
Unknown,																								
1992-1993	0	0	1	2	1	0	3	4	1	3	7	4	4	1	**4**	17	2	4	7	0	0	1	2	68
1993-1994	0	0	0	0	0	0	1	0	0	8	**15**	3	3	4	1	1	1	0	0	0	0	2	7	46
1994-1995	0	0	0	0	1	5	5	10	16	**16**	17	10	1	0	11	0	1	1	2	0	0	0	1	97
1995-1996[a]	0	0	0	0	0	0	0	0	1	4	15	**6**	13	0	0	1	0	1	0	5	0	0	1	47
1996-1997	0	0	0	0	1	0	2	6	14	3	**14**	17	5	1	3	2	1	3	0	0	0	0	1	73
1997-1998	0	0	0	0	1	0	4	4	2	5	**7**	4	9	1	2	1	1	0	2	0	1	0	0	44
1998-1999	0	0	0	0	0	4	5	3	3	3	4	**6**	2	0	0	1	2	2	2	3	1	1	3	45
1999-2000	0	0	0	0	0	0	0	1	2	2	12	**8**	2	0	0	1	0	0	3	1	1	0	3	36
2000-2001[b]	0	0	0	0	0	2	3	2	1	9	3	**3**	0	3	1	3	1	4	2	0	0	0	4	41
2001-2002	0	0	0	0	3	9	7	15	13	**10**	7	5	2	0	1	1	2	6	9	3	0	1	11	105
2002-2003	0	0	0	0	1	1	3	4	12	15	12	6	5	9	1	1	**7**	6	4	19	0	4	44	154
2003-2004	0	0	1	1	5	3	9	13	29	**10**	17	9	4	3	5	3	4	10	1	2	0	2	10	141
2004-2005	0	0	0	0	6	24	25	11	**36**	25	5	2	2	1	0	9	3	5	2	1	0	2	15	174
2005-2006	0	0	0	0	1	0	6	9	8	6	11	**9**	2	2	0	5	7	3	2	2	0	0	13	86
2006-2007[c]	0	0	0	0	1	0	1	1	3	3	4	4	2	1	1	1	0	**3**	0	0	0	0	20	45
2007-2008[d]	0	0	0	0	0	0	1	0	2	2	13	7	2	0	3	0	4	0	0	0	0	0	0	34

[a] Powerdale Dam trap was inoperative from 11-13 Nov 1995 and from 20-24 Nov 1995 because of flood damage and from 28 Nov 1995 – 27 Feb 1996 for modifications to the adult fish ladder.

[b] Preliminary estimates. Summaries are complete through 12 February, 2008.

[c] Powerdale Dam trap was inoperative from 6-22 November, 2006, from 12-21 December, 2006, and from 3-8 January, 2007 as a consequence of several catastrophic flood events in the Hood River subbasin.

[d] Preliminary estimates. Summaries are complete through 12 February, 2008.

[e] Adult with a valid Hood River stock winter steelhead mark, but were classified as a summer steelhead based on run timing and visual characteristics.

Table 18. Bimonthly counts of upstream migrant adult winter steelhead captured at the Powerdale Fish Facility, by origin and run year. Counts are boldfaced for the bimonthly period in which the median date of migration occurred in each origin category. Data source: Olsen (2008).

Origin, stock,	September		October		November		December		January		February		March		April		May		June		July		
run year	01-15	16-30	01-15	16-31	01-15	16-30	01-15	16-31	01-15	16-31	01-15	16-29	01-15	16-31	01-15	16-30	01-15	16-31	01-15	16-30	01-15	16-31	Total
Wild,																							
Hood River,																							
1991-1992	0	0	0	0	0	0	0	0	0	24	28	32	75	98	**152**	151	88	28	2	0	0	0	678
1992-1993	0	0	0	0	0	0	0	4	0	3	3	0	28	61	100	**79**	86	30	3	2	0	0	399
1993-1994	0	0	0	0	0	0	0	0	4	7	0	6	23	24	77	**128**	76	21	11	0	0	0	377
1994-1995	0	0	0	0	0	0	0	0	0	0	9	0	6	2	55	15	**52**	44	10	1	0	0	194
1995-1996	0	0	0	0	0	0	0	0	0	0	0	0	17	4	92	**40**	69	36	11	0	0	0	269
1996-1997	0	0	1	0	0	0	0	2	1	0	3	13	5	22	52	**72**	68	32	3	0	0	0	274
1997-1998	0	0	0	0	1	0	0	0	0	1	6	0	7	12	23	**107**	36	8	6	1	0	0	208
1998-1999	0	0	0	0	0	0	0	0	12	0	4	2	8	32	47	**121**	22	32	7	2	0	0	289
1999-2000	0	0	0	0	0	0	6	1	0	2	15	16	69	110	**320**	225	113	26	1	0	0	0	904
2000-2001	0	0	0	0	0	0	0	0	0	0	1	7	50	142	**313**	379	88	19	0	1	0	0	1,000
2001-2002	0	0	0	0	1	2	0	0	9	3	13	63	71	197	**278**	265	103	20	7	0	0	0	1,032
2002-2003	0	0	0	0	0	0	0	1	4	3	9	13	68	228	**251**	88	43	10	0	0	0	0	718
2003-2004	0	0	0	0	0	1	0	7	0	2	8	41	69	115	**154**	126	48	5	1	0	0	0	577
2004-2005	0	0	0	0	0	5	0	8	0	15	2	0	36	51	**81**	89	36	9	2	0	0	0	334
2005-2006	0	0	0	0	0	0	0	0	7	9	3	11	35	99	**118**	90	39	22	5	0	0	0	438
2006-2007	0	0	0	0	0	0	0	0	0	6	8	18	75	112	**98**	85	34	16	3	1	0	0	456
Subbasin hatchery,																							
Big Creek,																							
1991-1992	0	0	0	0	0	0	0	5	11	94	**54**	43	30	6	2	2	0	0	0	0	0	0	247
1992-1993	0	0	0	0	0	0	2	13	0	31	44	0	**39**	31	13	12	2	0	0	0	0	0	187
1993-1994	0	0	0	0	0	0	0	0	23	30	7	**35**	31	4	0	0	0	0	0	0	0	0	130
1994-1995	0	0	0	0	0	0	0	0	0	0	**5**	1	3	0	0	0	0	0	0	0	0	0	9
Mixed,[a]																							
1992-1993	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**4**	1	1	0	0	0	0	0	6
1993-1994	0	0	0	0	0	0	0	0	2	1	1	1	1	**2**	3	2	0	0	0	0	0	0	13
1994-1995	0	0	0	0	0	0	0	0	0	0	**4**	0	0	0	1	0	3	0	0	0	0	0	8
Hood River,																							
1993-1994	0	0	0	0	0	0	0	0	0	0	**0**	0	0	1	0	0	0	0	0	0	0	0	1

Table 18 (cont.). Bimonthly counts of upstream migrant adult winter steelhead captured at the Powerdale Fish Facility, by origin and run year. Counts are boldfaced for the bimonthly period in which the median date of migration occurred in each origin category. Data source: Olsen (2008).

Origin, stock,	September		October		November		December		January		February		March		April		May		June		July		
run year	01-15	16-30	01-15	16-31	01-15	16-30	01-15	16-31	01-15	16-31	01-15	16-29	01-15	16-31	01-15	16-30	01-15	16-31	01-15	16-30	01-15	16-31	Total
1994-1995	0	0	0	0	0	0	0	0	0	6	19	**17**	8	4	21	3	4	1	0	0	0	0	83
1995-1996	0	0	0	0	0	2	0	0	0	0	0	0	19	8	93	**47**	66	21	3	0	0	0	259
1996-1997	0	0	0	0	0	0	0	0	0	1	2	38	20	54	128	**171**	140	51	8	0	0	0	613
1997-1998	0	0	0	0	5	1	0	0	1	0	6	5	26	55	**87**	146	27	5	1	0	0	0	365
1998-1999	0	1	3	6	3	5	0	0	10	0	4	0	6	65	**75**	88	12	23	1	2	0	0	304
1999-2000	0	0	0	1	5	1	1	0	2	1	12	13	35	45	**83**	53	28	10	0	0	0	0	290
2000-2001	0	0	0	0	0	0	0	0	2	0	2	10	71	229	**306**	216	49	11	1	0	0	0	897
2001-2002	0	0	0	0	0	3	0	1	29	22	41	73	104	182	**246**	174	42	3	2	0	0	0	922
2002-2003	0	0	0	0	0	1	0	0	1	8	14	13	47	**163**	133	64	19	5	0	0	0	0	468
2003-2004	0	0	0	0	0	1	2	20	0	14	22	52	104	207	**186**	183	101	26	5	1	0	0	924
2004-2005	0	0	0	0	1	9	5	28	1	55	2	0	31	67	**94**	97	49	10	1	1	0	0	451
2005-2006	0	0	0	0	0	0	0	0	1	12	6	11	70	158	**256**	169	78	54	2	0	0	0	817
2006-2007	0	0	0	0	0	0	0	0	1	8	3	4	46	117	**100**	70	31	11	4	0	0	0	395
Hood River (Unknown),[b]																							
2000-2001	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**	0	0	0	0	0	0	0	0	3
2001-2002	0	0	0	0	0	0	0	0	2	4	16	30	12	**35**	49	9	2	0	0	0	0	0	159
2002-2003	0	0	0	0	0	0	0	0	0	1	0	0	0	9	**15**	3	1	0	1	0	0	0	30
2003-2004	0	0	0	0	0	0	0	1	0	0	0	1	**1**	0	0	0	3	0	0	0	0	0	6
2004-2005	0	0	0	0	0	0	0	0	0	9	0	0	5	7	**30**	6	1	0	0	0	0	0	58
2005-2006	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	**1**	1	1	0	0	0	0	5
2006-2007	0	0	0	0	0	0	0	0	0	0	0	0	4	**13**	4	1	0	1	0	0	0	0	23
Stray hatchery,																							
Unknown,																							
1991-1992	0	0	0	0	0	0	0	0	0	2	2	1	5	**4**	7	1	0	0	0	0	0	0	22
1992-1993	0	0	0	0	0	0	0	0	0	1	2	0	2	**9**	6	1	0	0	0	0	0	0	21
1993-1994	0	0	0	0	0	0	0	0	1	0	0	0	1	1	**11**	6	0	0	0	0	0	0	20
1994-1995	0	0	0	0	0	0	0	0	0	0	0	1	1	1	**0**	0	0	0	0	0	0	0	3
1995-1996	0	0	0	0	0	0	0	0	0	0	0	0	3	1	**2**	0	0	0	0	0	0	0	6
1996-1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	1	0	0	0	0	1	0	2
1997-1998	0	0	0	0	0	0	0	0	0	0	1	0	0	1	**0**	0	1	0	0	0	0	0	3

Table 18 (cont.). Bimonthly counts of upstream migrant adult winter steelhead captured at the Powerdale Fish Facility, by origin and run year. Counts are boldfaced for the bimonthly period in which the median date of migration occurred in each origin category. Data source: Olsen (2008).

Origin, stock,	September		October		November		December		January		February		March		April		May		June		July		
run year	01-15	16-30	01-15	16-31	01-15	16-30	01-15	16-31	01-15	16-31	01-15	16-29	01-15	16-31	01-15	16-30	01-15	16-31	01-15	16-30	01-15	16-31	Total
1998-1999	0	0	0	0	0	0	0	0	1	0	0	0	0	2	**1**	3	0	0	0	0	0	0	7
1999-2000	0	0	0	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0	0	0	1
2000-2001	0	0	0	0	0	0	0	0	0	0	0	3	3	7	**9**	8	2	0	0	0	0	0	32
2001-2002	0	0	0	0	0	0	0	0	4	2	4	9	9	**13**	22	9	2	1	0	0	0	0	75
2002-2003	0	0	0	0	0	0	0	0	0	2	2	4	6	**18**	20	8	1	0	0	0	0	0	61
2003-2004	0	0	0	0	0	0	0	1	0	0	1	1	6	**10**	7	7	1	0	0	0	0	0	34
2004-2005	0	0	0	0	1	0	0	0	0	2	0	0	0	2	**5**	4	3	0	0	0	0	0	17
2005-2006	0	0	0	0	0	0	0	0	3	1	0	0	1	0	**3**	0	4	1	0	0	0	0	13
2006-2007	0	0	0	0	0	0	0	0	0	2	0	0	4	4	**3**	2	4	2	1	0	0	0	22
Unknown,																							
Unknown,																							
1991-1992	0	0	0	0	0	0	0	0	4	22	**9**	7	6	5	3	8	4	2	0	0	0	0	70
1992-1993	0	0	0	0	0	0	1	4	0	6	7	0	**6**	5	4	2	3	0	0	0	0	0	38
1993-1994	0	0	0	0	0	0	0	0	6	3	0	1	6	**8**	5	5	3	2	0	0	0	0	39
1994-1995	0	0	0	0	0	0	0	1	0	0	5	3	0	0	**4**	1	2	2	2	0	0	0	20
1995-1996	0	0	0	0	0	0	0	0	0	0	0	0	2	1	9	**5**	5	3	0	0	0	0	25
1996-1997	0	0	0	0	0	0	0	0	0	0	0	5	1	6	**8**	8	7	4	1	0	0	0	40
1997-1998	0	0	0	0	0	0	0	0	0	0	0	4	9	5	**9**	11	5	1	0	0	0	0	44
1998-1999	0	0	1	0	0	0	0	0	1	1	0	0	1	2	**7**	6	1	2	0	0	0	0	22
1999-2000	0	0	0	0	0	1	0	0	0	0	0	3	0	3	**10**	5	6	0	0	0	0	0	28
2000-2001	0	0	0	0	0	0	0	0	0	0	0	0	4	6	**14**	10	1	0	0	0	0	0	35
2001-2002	0	0	0	0	0	0	0	0	2	0	6	4	6	11	**19**	13	2	0	0	0	0	0	63
2002-2003	0	0	0	0	0	0	0	0	0	1	0	5	10	10	**19**	14	3	3	0	0	0	0	65
2003-2004	0	0	0	0	0	0	0	1	0	2	2	9	13	18	**25**	18	2	4	1	0	0	0	95
2004-2005	0	0	0	0	0	0	0	3	0	4	0	0	3	8	**10**	12	3	0	0	0	0	0	43
2005-2006	0	0	0	0	0	0	0	0	2	0	0	0	9	13	19	**30**	14	6	0	0	0	0	93
2006-2007	0	0	0	0	0	0	0	0	0	1	0	2	5	18	**10**	9	6	2	0	0	0	0	53

a Returns from the 1991 brood are progeny of wild x Big Creek stock hatchery crosses.

b Adult steelhead with a valid Hood River stock summer steelhead amrk, but were classified as a winter steelhead based on run timing and visual characteristics.

Table 19. Number of wild Hood River steelhead collected for broodstock, spawned, released, and died, for the summer and winter steelhead stock 050 broodstock development program. Data source: Unpublished data on 4/26/2008 from mid-Columbia District Research, ODFW, The Dalles, Oregon.

	Summer Steelhead					Winter Steelhead				
		Spawned &		Unspawned			Spawned &		Unspawned	
Run Year	Collected	Released	Died	Released	Died	Collected	Released	Died	Released	Died
1992-1993						57	32	5	16	4
1993-1994						78	52	2	21	3
1994-1995						42	36	1	5	0
1995-1996						65	36	1	22	6
1996-1997						46	30	2	5	9
1997-1998	13	9	0	1	3	39	22	0	8	9
1998-1999	31	21	1	0	9	41	34	1	5	1
1999-2000	33	22	0	11	0	47	23	1	23	0
2000-2001	27	22	1	1	3	130	55	3	72	0
2001-2002	61	34	2	11	14	74	37	6	12	19
2002-2003	78	33	1	12	32	66	41	2	8	15
2003-2004	36	26	1	0	9	73	45	0	26	2
2004-2005	38	19	1	14	4	55	21	2	30	2
2005-2006	13	0	0	10	3	109	49	0	60	0
2006-2007	23	12	1	8	2	54	30	1	22	1

7.3) Identity.

(a) Methods for identifying target populations (if more than one population may be present).
Wild fish are identified based on lack of hatchery fin-marks or tags, along with scale analysis suggesting wild rearing. The proposed trapping site is located is the East Fork of Hood, which is not in the typical distribution of Hood River summer-run steelhead. Genetic markers, described previously, will also be utilized to further identify Hood River winter steelhead.
(b) Methods for identifying hatchery origin fish from naturally spawned fish.
All hatchery steelhead released in the Hood subbasin are differentially marked to distinguish between hatchery and wild fish, and between the different stocks of hatchery fish.

7.4) Proposed number to be collected:

7.4.1) Program goal (assuming 1:1 sex ratio for adults):

A total of 40 wild Hood River Winter steelhead will be needed for program goals. Up to 60 wild fish may be collected and reviewed to meet broodstock criteria, fish not meeting criteria will be returned to the river within 14 days of collection.

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:
The Hood River Production Program broodstock collection data are summarized in Table 20.

Table 20. Hood River Winter Steelhead – actual numbers and sex ratio of steelhead spawned. Data source: Olsen (2008).

Brood year	Adults Females	Males	Jacks	Green Eggs	Smolts
1991	3	1	NA	11,858	4,595
1992	18	23	NA	50,748	48,985
1993	16	21	NA	62,150	38,034
1994	26	28	NA	95,043	42,860
1995	18	19	NA	63,790	50,896
1996	24	29	NA	85,497	59,837
1997	27	27	NA	102,465	62,135
1998	21	21	NA	80,620	46,781
1999	29	33	NA	112,302	63,182
2000	20	19	NA	83,401	50,879
2001	27	35	NA	112,302	62,921
2002	20	23	NA	83,992	51,433
2003	22	22	NA	87,339	59,407
2004	22	24	NA	89,759	79,486
2005	14	15	NA	43,910	36,795
2006	21	29	NA	78,348	38,360
2007	18	16	NA	74,985	--

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.
It is anticipated that the proposed weir and trap will have a high capture efficiency rate. Hatchery fish returning to the trap in excess of escapement needs (<5% of wild winter steelhead escapement) will have four possible dispositions. Hatchery fish returning early in the run, in good physical condition, will be returned back downstream to the mouth of the Hood River where they will be again subjected to the fishery. Fish that return to the trapping facility after being recycled twice through the downstream fishery will be trucked to a nearby closed water body where they will be released to supplement a lake fishery. Excess hatchery fish, in good condition, may be sacrificed and provided to tribal members or local food banks for food. Fish returning late in the run or in poor condition will be sacrificed and utilized for stream enrichment purposes in the Hood River Basin. Individual management taken on each returning excess hatchery fish will depend upon particular condition of the fish, and needs of the fishery.

7.6) Fish transportation and holding methods.
Steelhead collected for broodstock will be transported from the Powerdale Fish Facility to the Parkdale Fish Facility. Transportation requires approximately 15 minutes. Fish

are anesthetized with carbon dioxide gas in a water solution prior to handling. The anesthetized fish are loaded into a portable fish transportation tank where they revive from the CO_2.

7.7) Describe fish health maintenance and sanitation procedures applied.

Once fish are transferred to the adult holding ponds they receive regular treatments with a formalin solution to prevent fungal infection. The fish are held in cold spring water, which helps to prevent disease or parasite problems.

The spawning area and equipment are routinely disinfected with an iodine solution to prevent disease outbreaks. Green eggs are water-hardened in an iodine solution to prevent disease or viral contamination. Ovarian fluid and sperm samples are collected and cultured for IHN virus

7.8) Disposition of carcasses.

Spawned and unspawned steelhead carcasses that receive disease clearance from the ODFW Fish Pathology Section will be frozen and used later for stream enrichment in the East, Middle and West fork of Hood River. The timing of the carcass placement is designed to provide maximum potential benefit to the juvenile salmonids and the ecosystem. Placement generally occurs in late spring or early summer, when the likelihood of significant freshets is minimal.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

The Hood River steelhead supplementation program includes a number of features that are designed to minimize adverse genetic or ecological effects to the listed natural fish, including:

1) Broodstock selection will not exceed 25% of the natural population measured at Powerdale Fish Facility.
2) Broodstock are collected randomly throughout the length of the run.
3) A 1:1 sex ratio is the target for the spawning of hatchery broodstock.
4) Hatchery-reared juveniles are not graded for size during rearing.
5) All the hatchery progeny are externally marked for ease of monitoring and evaluation.
6) Hatchery-reared smolts are acclimated for one to two weeks prior to volitional release into the subbasin. Non-migrant smolts are transported and released downstream near the mouth of Hood River.

SECTION 8. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1) Selection method.

Broodstock is collected from wild steelhead from throughout the run. Program targets are: 1) fish are paired at random from ripe fish, 2) fish are spawned with a single other individual, and 3) fish are spawned only once.

8.2) Males.

Backup males have been collected to insure that there are ripe males available for spawning with ripe females. Backup males also help insure that a segment of the run is represented in the hatchery egg take if the primary male were to die. Repeat spawners may be selected in the random brood selection process. If selected, these fish would be treated as any other male brood.

The target sex ratio for this program is 1 male for every 1 female. Actual sex ratios are reported in Table 5.

8.3) Fertilization.

The steelhead protocols include the goal of 1:1 sex ratios and one male one female family units. Gametes may be pooled, but only after the results of the IHN viral sampling verifies negative results.

ODFW has a department-wide fish disease control and prevention program. This program is documented in the Oak Springs hatchery operational plan (Nandor 1995) and observed throughout the steelhead incubation and rearing process. Prior to spawning, anesthetized adults are dried and wiped down with an iodine solution. Ovarian fluid and sperm samples are collected during spawning and later analyzed for the presence of IHN virus. Green eggs are water-hardened in an iodine antiseptic solution. The eggs are rinsed and treated with another iodine solution bath prior to initiation of the incubation process.

8.4) Cryopreserved gametes.

Cryogenically preserved gametes are not used in these hatchery programs.

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

Broodstock are selected at random from throughout the winter steelhead run. Spawning is done randomly based on availability of ripe fish. Matings are done on a 1:1 sex ratio (i.e. one male and one female).

SECTION 9. INCUBATION AND REARING -

Specify any management *goals* (e.g. "egg to smolt survival") that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

See table 18 for recent egg take and egg to smolt survival data for winter steelhead at the Oak Springs Hatchery. For the 2007 brood, egg loss was 2.6% of total production, and fry loss was 1.3%.

9.1.2) Cause for, and disposition of surplus egg takes.

Extra steelhead eggs are typically collected in order to compensate for egg-to-smolt mortality. Surplus eggs, culled eggs and surplus fish are all disposed of by burial.

9.1.3) Loading densities applied during incubation.

Egg sizes are not routinely monitored. Standard flows are set at 4 gpm through the isolation incubation Marisource trays and 5 gpm on the standard incubation Marisource trays. Summer and winter egg densities are determined by spawning / family group sizes. Egg densities are never higher than 1 female per incubation trap or 5,000 to 6,000 eggs per tray.

9.1.4) Incubation conditions.

Incubation of steelhead eggs begins either on 38 to 40° spring water at the Parkdale Fish Facility, or chilled, 43° water at Oak Springs Fish Hatchery. The eggs are chilled to retard development and allow later egg takes to catch up with the earlier eggs. Influent and effluent dissolved oxygen levels at Oak Springs Fish Hatchery have not been previously monitored, but are now being monitored.

Silt management is not an issue because both incubation sites use clean spring water.

9.1.5) Ponding.

Steelhead fry are ponded at between 994 and 1,095 temperature units. Fry are inspected daily beginning at 950 temperature units, and are ponded when an estimated 90% of the fry are buttoned up. Lengths and weights have not been sampled at ponding. The ponding rates can range from mid-June to late July. Ponding is forced, swim up is volitional, and feeding begins when an estimated 90% of the fry have surfaced in the pond. This usually occurs within four days of ponding.

9.1.6) Fish health maintenance and monitoring.

Incubating eggs are treated daily with a formalin solution at a rate of 1:600 for 10 to 15 minutes until hatching to prevent fungus. After ponding, fish are regularly monitored monthly for any obvious disease or parasite problems by a certified ODFW pathologist. ODFW fish pathologists routinely monitor the fish during their rearing cycle and prescribe any therapeutic treatments deemed necessary.

Hood River steelhead have been reared at Oak Springs Fish Hatchery for 15 brood years. There has been no egg yolk-sac malformation, or fry or fingerling deformities or disease problems.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.
Broodstock are selected from throughout the entire steelhead run. Fish are spawned on a 1:1 sex ratio with one male and one female parent per family group. Incubation water supply systems at Parkdale and Oak Springs utilize spring water sources where water quality is not an issue of concern.

9.2) Rearing:

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available..
For the 2007 brood year egg loss was 2.6%, and fry loss was 1.3%.

9.2.2) Density and loading criteria (goals and actual levels).
Steelhead densities in the Canadian troughs are kept below 5 pounds of fish per gpm inflow, and 10 pounds per cubic foot of water volume. Steelhead transferred to 30 foot diameter circular ponds are kept at densities below 6 pounds of fish per gpm inflow and 7 pounds per cubic foot of volume. Steelhead later transferred to the 46x8 foot raceway ponds are kept at densities of 8.3 pounds per gpm of inflow and 2 pounds per cubic foot of volume. All the water used in the various containers for the steelhead rearing is single use water with no re-use.

9.2.3) Fish rearing conditions
Monitoring of Oak Springs Fish Hatchery water influent and effluent water was not done for the 1999 steelhead brood year production, but will be done for the 2000 brood year production.

9.2.4) Indicate biweekly or monthly fish growth information (*average program performance*), including length, weight, and condition factor data collected during rearing, if available.
There were two raceway ponds of Hood stock winter steelhead and one raceway of Hood stock summer steelhead. Table 21 summarizes the length, weight and condition factor for these three groups of fish.

Table 21a. Mean fork length (FL; mm), weight (gm), and condition factor (CF) for Hood River stock hatchery summer steelhead smolts sampled at Oak Springs Hatchery prior to being transferred to the Hood River subbasin[a] (Olsen 2008). Estimates are for early- and late- release groups.

Statistic, release group, brood year[b]	N	Mean	Range	95% CI
FL (mm),				
Early,				
1998[c]	246	189.6	109 - 235	± 2.2
1999	201	188.0	122 - 247	± 2.6
2000	220	169.6	87 - 223	± 3.7
2001	195	203.8	129 - 260	± 3.3
2002 (G1;L2)	204	200.7	107 - 258	± 3.5
2002 (G2;L1)	221	207.8	105 - 270	± 3.2
2002 (G2;L2)	213	207.1	126 - 278	± 3.1
2003 (G1;L1)	203	194.9	90 - 245	± 3.9
2003 (G1;L2)	202	195.3	105 - 241	± 3.6
2004 (G1;L1)	217	190.3	108 - 245	± 3.3
2004 (G2;L1)	207	200.4	108 - 254	± 3.3
2004 (G2;L2)	205	196.3	119 - 252	± 2.9
2005 (L4)	211	210.3	136 - 260	± 3.2
2006[d]				
Late,				
1998	--			
1999	201	201.7	133 - 249	± 2.3
2000	145	183.1	96 - 256	± 5.4
2001	204	216.5	130 - 276	± 3.6
2002	209	201.7	104 - 299	± 3.7
2003	260	208.1	97 - 273	± 3.0
2004	201	207.4	135 - 266	± 3.1
2005 (L3)	205	202.1	120 - 261	± 3.5
2006[d]				
Weight (gm),				
Early,				
1998[c]	244	82.4	12.8 - 152.4	± 2.8
1999	201	72.1	19.5 - 178.6	± 3.1
2000	220	56.4	6.8 - 129.3	± 3.5
2001	195	95.8	20.5 - 188.8	± 4.5
2002 (G1;L2)	200	91.0	31.6 - 187.1	± 4.2
2002 (G2;L1)	221	96.7	13.8 - 215.3	± 4.3
2002 (G2;L2)	213	95.7	20.4 - 224.1	± 4.4
2003 (G1;L1)	203	87.9	8.3 - 180.4	± 4.3
2003 (G1;L2)	201	87.0	10.2 - 179.3	± 3.9
2004 (G1;L1)	213	86.1	17.3 - 198.0	± 4.4
2004 (G2;L1)	206	91.1	15.5 - 193.3	± 4.3
2004 (G2;L2)	205	85.3	17.1 - 186.0	± 3.5
2005 (L4)	209	104.8	23.7 - 189.6	± 4.4
2006[d]				

Table 21a. Mean fork length (FL; mm), weight (gm), and condition factor (CF) for Hood River stock hatchery summer steelhead smolts sampled at Oak Springs Hatchery prior to being transferred to the Hood River subbasin[a] (Olsen 2008). Estimates are for early- and late- release groups.

Statistic, release group, brood year[b]	N	Mean	Range	95% CI
Late,				
1998	--			
1999	201	85.0	29.1 - 185.2	± 3.0
2000	144	74.8	8.6 - 194.0	± 6.4
2001	203	111.7	24.8 – 251.7	± 5.6
2002	209	90.8	13.8 – 322.8	± 5.2
2003	246	99.1	10.6 – 240.3	± 4.2
2004	200	109.7	28.4 – 219.4	± 5.0
2005 (L3)	205	91.3	18.3 – 180.8	± 4.5
2006[d]				
CF,[e]				
Early,				
1998[c]	244	1.17	0.84 – 1.37	± 0.009
1999	201	1.05	0.79 – 1.35	± 0.008
2000	220	1.06	0.73 – 1.26	± 0.01
2001	195	1.09	0.77 – 1.48	± 0.01
2002 (G1;L2)	200	1.06	0.66 – 1.38	± 0.01
2002 (G2;L1)	221	1.04	0.80 – 1.36	± 0.01
2002 (G2;L2)	213	1.04	0.47 – 1.34	± 0.01
2003 (G1;L1)	203	1.13	0.92 – 1.45	± 0.01
2003 (G1;L2)	201	1.11	0.77 – 1.35	± 0.01
2004 (G1;L1)	213	1.17	0.51 – 1.60	± 0.02
2004 (G2;L1)	206	1.08	0.83 – 1.26	± 0.01
2004 (G2;L2)	205	1.10	0.86 – 2.29	± 0.01
2005 (L4)	209	1.09	0.93 – 1.27	± 0.009
2006[d]				
Late,				
1998	--			
1999	201	1.02	0.87 – 1.24	± 0.008
2000	144	1.10	0.76 – 1.31	± 0.01
2001	203	1.06	0.71 – 1.88	± 0.01
2002	209	1.05	0.84 – 1.31	± 0.01
2003	246	1.06	0.78 – 1.36	± 0.01
2004	200	1.19	0.86 – 1.53	± 0.02
2005 (L3)	205	1.06	0.65 – 1.34	± 0.01
2006[d]				

[a] Juveniles were sampled approximately one to seven days prior to transfer.

[b] G1 = group 1, G2 = group 2, L1 = pond L-1, L2 = pond L-2.

[c] Juveniles were sampled two weeks prior to transfer in mid-April.

[d] No production release was made from the 2006 brood.

[e] Condition factor was estimated as (100*weight(gm)/length(cm)^3).

Table 21b. Mean fork length (FL; mm), weight (gm), and condition factor (CF) for Hood River stock hatchery winter steelhead smolts sampled at Oak Springs Hatchery prior to being transferred to the Hood River subbasin[a] (Olsen 2008). Estimates are for early- and late- release groups.

Statistic, release group, brood year[b]	Size group	N	Mean	Range	95% CI
FL (mm),					
June,					
1993[c]	--	130	183.8	115 – 234	± 4.2
Early,					
1993	Large	185	200.2	144 – 246	± 2.9
1993	Small	193	192.7	82 – 283	± 3.9
1994	Large	200	196.9	138 – 247	± 2.5
1994	Small	207	185.7	116 – 234	± 2.7
1995	Large	208	196.1	93 – 236	± 2.6
1996	Large	203	196.5	118 – 242	± 2.5
1997	Large	199	193.1	91 – 240	± 2.9
1998	Large	200	189.2	125 – 232	± 2.3
1999	Large	208	181.0	117 – 228	± 2.6
2001 (G1;L3)	--	258	175.9	98 – 241	± 3.5
2001 (G1;L4)	--	204	173.5	109 – 250	± 4.1
2002	--	207	187.9	108 – 245	± 3.5
2003 (G1;L5)	--	200	179.6	90 – 250	± 4.5
2003 (G1;L6)	--	208	179.2	85 – 250	± 4.3
2004 (L3)	--	204	167.1	83 – 232	± 4.2
2004 (L4)	--	204	180.8	95 – 234	± 3.6
2005 (L1)	--	210	153.8	94 – 223	± 3.3
2005 (L2)	--	216	159.7	86 – 226	± 3.1
2006 (G1;L1)	--	211	182.5	90 – 267	± 3.7
2006 (G2;L2)	--	226	188.5	96 – 236	± 2.9
Late,					
1995[d]	--	--	--	--	--
1996	Small	192	168.2	90 – 225	± 3.7
1997	Small	205	173.8	89 – 218	± 3.1
1998	Small	195	194.9	92 – 268	± 3.6
1999	Small	196	180.6	119 – 224	± 2.7
2000	Large	195	198.2	134 – 242	± 3.0
2000	Small	203	182.3	98 – 244	± 3.4
2001 (G1;L3)	--	200	194.0	109 – 279	± 4.3
2001 (G1;L4)	--	216	193.0	109 – 275	± 3.7
2002	--	205	188.7	100 – 265	± 3.8
2003	--	253	203.8	101 – 258	± 3.2
2004	--	207	179.8	94 – 246	± 4.1
2005 (L1)	--	200	179.8	104 – 237	± 3.6
2006 (L1)	--	228	189.7	104 – 243	± 3.1
Weight (gm),					
June,					
1993[c]	--	129	69.5	16.0 – 145.5	± 4.8
Early,					
1993	Large	185	91.1	33.1 – 168.5	± 3.8
1993	Small	192	87.2	6.1 – 236.4	± 4.6
1994	Large	199	86.2	29.6 – 172.1	± 3.2

Table 21b (cont.). Mean fork length (FL; mm), weight (gm), and condition factor (CF) for Hood River stock hatchery winter steelhead smolts sampled at Oak Springs Hatchery prior to being transferred to the Hood River subbasin[a] (Olsen 2008). Estimates are for early- and late- release groups.

Statistic, release group, brood year[b]	Size group	N	Mean	Range	95% CI
1994	Small	207	72.8	16.5 - 154.0	± 3.1
1995	Large	205	89.6	8.7 - 163.5	± 3.1
1996	Large	202	86.0	18.1 - 164.3	± 3.2
1997	Large	198	88.7	9.9 - 191.1	± 3.5
1998	Large	200	76.2	21.7 - 145.4	± 2.8
1999	Large	208	64.9	16.4 - 133.3	± 3.0
2001 (G1;L3)	--	219	65.5	9.4 - 168.1	± 4.1
2001 (G1;L4)	--	201	66.0	14.3 - 223.5	± 4.9
2002	--	207	77.9	12.5 - 165.1	± 4.1
2003 (G1;L5)	--	199	77.8	10.9 - 210.0	± 5.1
2003 (G1;L6)	--	208	72.3	7.3 - 180.6	± 4.5
2004 (L3)	--	198	56.8	6.2 - 150.4	± 3.9
2004 (L4)	--	200	69.3	9.5 - 142.8	± 3.9
2005 (L1)	--	209	43.6	9.1 - 115.6	± 2.8
2005 (L2)	--	214	48.4	6.6 - 107.2	± 2.6
2006 (G1;L1)	--	210	71.3	7.9 - 253.3	± 3.9
2006 (G2;L2)	--	226	76.7	9.8 - 150.0	± 3.4
Late,					
1995[d]	--	--	--	--	--
1996	Small	191	53.4	5.7 - 109.8	± 3.3
1997	Small	202	60.7	7.3 - 115.8	± 2.9
1998	Small	195	84.1	7.9 - 190.1	± 4.3
1999	Small	195	62.9	17.4 - 134.3	± 2.8
2000	Large	192	89.8	26.1 - 176.0	± 3.7
2000	Small	202	73.4	13.5 - 164.6	± 3.8
2001 (G1;L3)	--	199	86.2	14.4 - 282.6	± 6.0
2001 (G1;L4)	--	215	84.0	14.9 - 262.6	± 5.0
2002	--	205	76.7	12.2 - 183.3	± 4.2
2003	--	250	95.4	14.9 - 208.3	± 4.2
2004	--	207	66.1	8.9 - 166.9	± 4.0
2005 (L1)	--	198	70.6	12.3 - 151.5	± 3.8
2006 (L1)	--	228	74.0	13.9 - 147.7	± 3.2
CF,[e]					
June,					
1993[c]	--	129	1.06	0.88 - 1.22	± 0.01
Early,					
1993	Large	185	1.10	0.93 - 1.31	± 0.009
1993	Small	192	1.15	0.97 - 1.35	± 0.01
1994	Large	199	1.10	0.97 - 1.24	± 0.007
1994	Small	207	1.10	0.94 - 1.25	± 0.007
1995	Large	205	1.16	0.95 - 1.37	± 0.01
1996	Large	202	1.10	0.91 - 1.39	± 0.01
1997	Large	198	1.19	1.02 - 1.39	± 0.01
1998	Large	200	1.10	0.97 - 1.31	± 0.008
1999	Large	208	1.06	0.85 - 1.50	± 0.01
2001 (G1;L3)	--	219	1.12	0.76 - 1.36	± 0.01

Table 21b (cont.). Mean fork length (FL; mm), weight (gm), and condition factor (CF) for Hood River stock hatchery winter steelhead smolts sampled at Oak Springs Hatchery prior to being transferred to the Hood River subbasin[a] (Olsen 2008). Estimates are for early- and late- release groups.

Statistic, release group, brood year[b]	Size group	N	Mean	Range	95% CI
2001 (G1;L4)	--	201	1.16	0.91 - 1.71	± 0.01
2002	--	207	1.11	0.78 - 1.42	± 0.006
2003 (G1;L5)	--	199	1.23	0.95 - 1.65	± 0.01
2003 (G1;L6)	--	208	1.16	0.86 - 1.61	± 0.02
2004 (L3)	--	198	1.11	0.95 - 1.39	± 0.01
2004 (L4)	--	200	1.10	0.95 - 1.34	± 0.009
2005 (L1)	--	209	1.11	0.70 - 1.41	± 0.01
2005 (L2)	--	214	1.11	0.61 - 1.33	± 0.01
2006 (G1;L1)	--	210	1.11	0.89 - 1.54	± 0.01
2006 (G2;L2)	--	226	1.10	0.82 - 1.40	± 0.01
Late,					
1995[d]	--	--	--	--	--
1996	Small	191	1.04	0.63 - 1.67	± 0.01
1997	Small	202	1.10	0.90 - 1.35	± 0.009
1998	Small	195	1.09	0.76 - 1.24	± 0.01
1999	Small	195	1.04	0.69 - 1.29	± 0.01
2000	Large	192	1.13	0.94 - 1.50	± 0.01
2000	Small	202	1.16	0.79 - 1.43	± 0.01
2001 (G1;L3)	--	199	1.10	0.93 - 1.41	± 0.01
2001 (G1;L4)	--	215	1.10	0.86 - 1.36	± 0.01
2002	--	205	1.08	0.86 - 1.31	± 0.006
2003	--	250	1.08	0.79 - 1.45	± 0.01
2004	--	207	1.06	0.86 - 1.25	± 0.009
2005 (L1)	--	198	1.14	0.85 - 1.47	± 0.01
2006 (L1)	--	228	1.04	0.87 - 1.33	± 0.01

[a] Juveniles were sampled approximately one to seven days prior to transfer.

[b] G1 = group 1, G2 = group 2, L3 = pond L-3, L4 = pond L-4, L5 = pond L-5, L6 = pond L-6.

[c] Juveniles were sampled four days prior to release on 28 June 1994.

[d] No juveniles were sampled from this brood release.

[e] Condition factor was estimated as (100*weight(gm)/length(cm)^3).

9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available.

No growth rate or energy reserve data has been collected.

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Winter steelhead reared at Oak Springs Fish Hatchery are started on Bio-Products BioVita Starter diets through 90 fish/lb, then switched to Bio Olympic fry diets through 6 weeks prior to acclimation. At that point, the finishing diet is Ewos New Age Pacific with 40 ppm astaxanthin and the "Boost" immune system feed supplement. The 7 yr average total amount of annual feed usage is 8707 pounds. The 7 yr average food conversion is .91.

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.
Fish health of rearing juvenile winter steelhead is monitored monthly by ODFW fish pathologists. The fish pathologists diagnosis disease problems and prescribe the appropriate treatments to eliminate or control the disease. An iodine antiseptic is routinely used to sanitize hatchery equipment and prevent the incidence or spread of disease.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.
The only index of smolt development collected at the hatchery is the condition factor data collected prior to liberation.

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.
Steelhead reared at Oak Springs Fish Hatchery are subject to minimal human disturbance. All feeding is automated. Fish transported to acclimation facilities in the Hood River subbasin experience natural-colored pond walls and/or in-water structure to simulate natural rearing conditions. Human contact is minimized during the acclimation.

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.
Hatchery-reared Hood stock winter steelhead are the progeny of parents selected from throughout the run year. There is no size grading of juveniles during the yearling rearing program. Human interactions with the rearing steelhead is minimal. The fish are acclimated in ponds with natural cover added and the Parkdale Fish Facility has camouflaged pond walls designed to simulate the natural stream environment. Fish are allowed to volitionally migrate from the acclimation ponds into the Hood River system.

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels.

Table 22. Hood River Winter Steelhead proposed hatchery-reared releases in the Hood subbasin. Data source: ODFW, unpublished.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs	NA	NA	NA	NA
Unfed Fry	NA	NA	NA	NA
Fry	NA	NA	NA	NA
Fingerling	NA	NA	NA	NA
Yearling	50,000*	5/pound	April	East Fork Hood River
Yearling	*	5/pound	April	Middle Fork Hood River

* Releases into the Middle Fork Hood River are pending evaluation of barrier waterfalls that developed following the November 2006 floods.

10.2) Specific location(s) of proposed release(s).

Winter Steelhead
Stream, river, or watercourse: East Fork Hood River
Release point: RM 6.0
Major watershed: Hood River
Basin or Region: Columbia River

Winter Steelhead
Stream, river, or watercourse: Middle Fork Hood River
Release point: RM 3.5
Major watershed: Hood River
Basin or Region: Columbia River

10.2) Actual numbers and sizes of fish released by age class through the program.
See Table 23.

Table 23. Hood River Winter Steelhead releases, 1992-2007. Data source: Olsen (2008).

Release year	Eggs/ Unfed Fry	Avg size	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
1992							4,595	4.6
1993							48,985	5.8
1994							38,034	4.9
1995							42,860	5.4
1996							50,896	5.3
1997							59,837	7.1
1998							62,135	6.4
1999							46,781	5.9
2000							63,182	7.7
2001							50,879	5.6
2002							62,921	5.8
2003							51,433	5.7
2004							59,407	5.5
2005							79,486	7.7
2006							36,795	10.2
2007							38,360	6.2
Average							49,787	6.2

10.4) Actual dates of release and description of release protocols.
Steelhead smolts are transported to Hood River acclimation ponds beginning in early April. The volitional release of steelhead smolts is generally complete by early May. Release of steelhead smolts from acclimation ponds is based on the following criteria: 1) smolt readiness in terms of appearance, crowding at the pond outlet, etc. and 2) release time that corresponds to natural smolt outmigration. Smolts are volitionally released for about two weeks. No migrants are forced out of the ponds. Non-migrants are subsequently trucked and released in the lower ¼ mile of Hood River.

10.5) Fish transportation procedures, if applicable.

Steelhead are transported from Oak Springs Fish Hatchery to acclimation ponds in the Hood River subbasin. Fish are in transit about two hours. Temperatures are regulated to match the receiving water. Transport trucks are equipped with oxygen to super-saturate truck water.

10.6) Acclimation procedures.

Release of steelhead smolts from acclimation ponds is based on the following criteria: 1) smolt readiness in terms of appearance, crowding at the pond outlet, etc. and 2) release time that corresponds to natural smolt outmigration. Smolts are volitionally released for about two weeks. No migrants are forced out of the ponds. Non-migrants are subsequently trucked and released in the lower ¼ mile of Hood River. Table 22 provides release information.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

One hundred percent of the winter steelhead smolts are marked with distinctive combination of external fin clips that enable fish managers to distinguish fish from individual releases groups by brood year. Specific broods of winter steelhead smolts may be partially, or entirely, coded wire tagged and fin-clipped.

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

Releases have been within the programmed and approved levels. There have not been any surplus fish.

10.9) Fish health certification procedures applied pre-release.

Fish must be certified by ODFW pathologists prior to release.

10.10) Emergency release procedures in response to flooding or water system failure.

In the event of a water system failure, fish would be forced from the acclimation pond. Standby pumps are ready at each acclimation site to re-circulate water during an emergency.

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

The steelhead smolts are the progeny of parents that were collected at random throughout the respective steelhead run. The juvenile steelhead are not graded for size while in the fish hatchery. The smolts are acclimated prior to release into the Hood River system. The smolts volitionally migrate from the acclimation ponds during approximately the same period that naturally produced smolts are emigrating from the system. To reduce potential interaction between naturally produced smolts and other resident salmonids non-migrants are not forced from the acclimation ponds, but are transported for release near the mouth of Hood River.

Table 24. Hood River stock hatchery winter steelhead acclimated in the East Fork and Middle Fork Hood River drainage, 1996-2000 releases.[a] Data source: Olsen and French (2000).

Drainage, Location, Release year, Release group	Date transferred to raceway	Number transferred to raceway	Fish/lb at transfer	Number of days acclimated	Mortalities[b] in acclimation raceway	Number[c] volitionally released	Number[d] trucked	Total[e] released
East Fork,								
Toll Bridge Park,								
1996,								
Group 1	Apr 1-4	24,057	5.7	9-12	26	24,031		24,031
Group 2	Apr 22-24	26,965	5.0	8-10	92	20,885	5,988	26,873
EFID Sand Trap,								
1997,								
Group 1	Apr 11-15	27,740	5.7	6-10	29	27,711		27,711
Group 2	Apr 29	32,578	8.3	6	452	32,126		32,126
1998,								
Group 1	Apr 7	29,510	5.2	7	0	29,510		29,510
Group 2	Apr 21	32,626	7.5	7	0	31,707	919 (1)	32,625
1999,								
Group 1	Apr 6	13,439	5.6	9	4	12,430	1,005 (1)	13,434
Group 2	Apr 29	13,630	5.8	6	2,052	10,572	1,006 (1)	11,577
2000,								
Group 1	Apr 12	14,599	7.3	5	1	13,852	746	14,598
Group 2	Apr 25-26	16,558	7.8	5-6	20	15,694	844	16,538
Middle Fork,								
Parkdale Fish Facility,								
1999,								
Group 1	Apr 6-7	10,012	5.5	8-9	2	9,859	153	10,010
Group 2	Apr 28	9,975	6.0	7	7	9,816	152	9,968
2000,								
Group 1	Apr 11	15,912	7.3	6	8	15,279	625 (50)	15,854
Group 2	Apr 25	16,235	7.7	6	20	15,578	637 (50)	16,165

[a] In the release year 1999, 1,792 smolts were direct released by truck from Oak Springs Hatchery personnel (ODFW) into the mainstem Hood River below Powerdale Dam.
[b] Of the total 481 mortalities in 1997, 442 were the result of sampling smolts which did not emigrate volitionally from the acclimation raceway. Of the total 2,052 mortalities recorded in 1999 at the EFID Sand Trap, 1,992 fish were the result of hauling fish to the acclimation site and 123 were from seining and holding fish for the Coanda screen testing.
[c] Of the total 59,837 released in 1997, 2,545 did not emigrate volitionally of which 2,103 were forced out into the East Fork Hood River.
[d] Number trucked indicates hatchery winter steelhead which did not emigrate volitionally from the acclimation raceways and were hauled and released near the mouth of the Hood River. In parentheses are mortalities from fish truck liberations.
[e] Mortality from the number trucked was subtracted from the total released.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

11.1) Monitoring and evaluation of "Performance Indicators" presented in Section 1.10.
Rationale: Two of the primary goals of the Hood River Production Program (HRPP) are to "**1) to increase production of wild summer and winter steelhead (*Oncorhynchus mykiss*) commensurate with the subbasins current carrying capacity and 2) provide in-basin sustainable harvest opportunities.**" (Coccoli 2004). The various strategies that have been proposed to achieve the HRPP's goal's and biological fish objectives are currently based on various assumptions relative to subbasin carrying capacity, egg-to-smolt and smolt-to-adult

survival rates, pre-spawning mortality rates, and race specific wild and hatchery escapements to the mouth of the Hood River subbasin. The monitoring and evaluation (M&E) component of this plan proposes implementing strategies designed to collect species, race and stock specific life history, production, escapement, run size, morph metric, meristic, and genetic information on juvenile and adult life history stages of steelhead escaping to the Hood River subbasin. The empirical data that will be collected under the umbrella of the M&E plan will be used to 1) refine the subbasins numerical fish objectives for wild summer and winter steelhead, to more accurately reflect the subbasins current and potential species and race specific spawner escapement and smolt production carrying capacities; 2) refine the numerical fish objectives for subbasin spawner escapement and harvest of summer and winter steelhead, 3) more accurately estimate species, race, and stock specific subbasin smolt-to-adult survival rates; 4) evaluate acclimation facilities; 5) monitor the incidental catch/take of wild and hatchery summer and winter steelhead in mainstem Columbia River fisheries, 6) develop guidelines for implementing the HRPP in a biologically sound manner, 7) evaluate both the Pelton ladder rearing facility and the proposed expanded hatchery facility at Parkdale, 8) develop guidelines for implementing the hatchery supplementation program in a manner that will minimize the HRPP’s impact on indigenous populations of resident and anadromous salmonids; and 9) develop and refine strategies and guidelines for implementing the HRPP in a manner that will improve program efficiency and benefits.

A comprehensive monitoring and evaluation (M&E) program for steelhead is required, in a narrow sense, to collect the life history and escapement information needed to 1) evaluate the HRPP relative to its performance criteria and 2) determine whether or not the assumptions used to develop the HRPP's biological fish objectives are valid, or need to be revised. However, an effective M&E program should not be strictly limited to collecting only that data required to address subbasin specific data gathering needs. The scope of a strong M&E program should be such that it will provide data that has a much broader regional application. The M&E component of this plan proposes implementing various strategies that have been designed to produce the empirical data which is requested on a regular basis by fisheries managers who have been assigned the task of developing sound biologically based decisions for protecting runs of steelhead in the Columbia River Basin. Primarily with respect to evaluating the impact of mainstem Columbia River fisheries on listed species of steelhead. One case in point would be the various strategies which have been proposed to provide the types of empirical stock specific data which are required by the National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS) to develop a biologically sound plan for protecting Columbia Basin stocks of listed wild summer and winter steelhead; or more broadly to protect runs of Columbia Basin stocks of steelhead in general. The M&E program proposed in this plan is designed, in part, to quantify the migration timing of steelhead through the fishery below Bonneville Dam, and to refine estimates of exploitation rates on winter steelhead in the Bonneville pool fishery. The NPCC identifies the critical nature of the data gathering efforts identified in this plan by stating that "**Some ongoing artificial production projects have monitoring planning or research elements embedded in them. When these elements address monitoring questions or needs relevant to the region such projects should no longer be viewed solely as hatchery projects, but should be identified as dedicated monitoring or research projects warranting long-term funding commitments**" (NPCC draft). The broader regional application of the data gathering efforts of the existing M&E project in the Hood River subbasin has been recognized by both the Independent Scientific Review Panel (ISRP) and the Independent Scientific Advisory Board (ISAB) when they state that "**Based on projects that were reviewed by the ISAB (2003) and the ISRP in various provincial and three-step reviews, likely candidates to contribute to this basin level evaluation include Hood River steelhead,** " (ISRP and ISAB 2005). The M&E program in this plan proposes a continuation of the HRPP's existing M&E project, and has been designed to provide the needed flexibility required to address any future data gathering needs that are identified by the Hood River subbasins fishery co-managers.

The HRPP's existing M&E steelhead project maintains a long term data set comprised of race and stock specific steelhead data relative to the Hood River subbasin's 1) smolt production, 2) egg-to-smolt and smolt-to-adult survival rates, 3) non-tribal harvest, and 4) escapements. Subbasin specific data is also available on rainbow-steelhead rearing densities and selected physical and environmental production constraints. The above data has been applied to several models (i.e., Unit Characteristic Method [UCM] model and the Ecosystem Diagnosis and Treatment [EDT] model) used to estimate production and survival in other Columbia River Basins; data which is requested on a periodic basis in order to update these models. Data collected at Bonneville Dam (i.e., in coordination with the Washington Department of Fish and Wildlife [WDFW]), in the Hood River creel, and at Powerdale Dam has collectively been used to estimate harvest in the Bonneville Pool, and it is anticipated that the recovery/detection of PIT tagged Hood River stock adult summer and winter steelhead will be instrumental in 1) refining estimates of steelhead harvest in the Bonneville Pool, 2) providing information critical to estimating Hood River stock summer and winter steelhead escapements to both Bonneville Dam and the Hood River subbasin (i.e., post Powerdale Dam removal), 3) monitoring migration timing of summer and winter steelhead through the spring fishery below Bonneville Dam, and 4) providing information that can be used to evaluate incidental catch of steelhead in mainstem Columbia River fisheries. Data collected on the reproductive success of both indigenous and non-indigenous stocks of steelhead in the Hood River subbasin will provide information critical to developing biologically sound guidelines for implementing hatchery supplementation projects in other subbasins (*see* Araki and Blouin 2005; Blouin and Araki 2004; Blouin and Araki 2005; Blouin and Araki 2006; Araki et al. 2007*a*; Araki et al. 2007*b*; and Araki et al. 2007*c*).

The HRPP's existing M&E steelhead project is comprehensively outlined and defined in the Hood River and Pelton ladder master plans (O'Toole and ODFW 1991*a*, O'Toole and ODFW 1991*b*, and Smith and CTWSRO 1991) and in the Hood River/Pelton Ladder Master Agreement (ODFW and CTWSRO Undated*a*). The master plans were approved by the Council in 1992 and the Master Agreement was submitted to BPA in 1993. The need for an M&E component to the HRPP is also identified in the Columbia River Anadromous Fish Restoration Plan of the Nez Perce, Umatilla, Warm Springs and Yakama Tribes (CRITFC 1996); as one of several actions required to improve wild production in the Hood River subbasin. The HRPP's existing M&E project also provides information that has regional application in evaluating other programs, projects, and fishery management decisions/actions that directly, or indirectly, impact listed runs of both summer and winter steelhead in the Columbia River Basin.

11.1.1) Describe plans and methods proposed to collect data necessary to respond to each "Performance Indicator" identified for the program.

Performance Indicators (*see* Coccoli 2004)

Summer steelhead:

Obj. 1. Achieve and maintain an average wild/natural origin spawning population of 600 adult summer steelhead returning to the Hood River by 2019.

Obj. 2. Make 1,100 summer steelhead available for harvest in the Hood River subbasin.

Obj. 3. Achieve an increase in habitat carrying capacity from 13,860 smolts to 20,000 smolts by 2019. This assumes a 3% smolt-to-adult survival rate to meet the 600 adult objective.

Obj. 4. Maintain the unique genetic character of wild summer steelhead in the Hood River.

Winter steelhead:

Obj. 1. Achieve and maintain an average wild/natural origin spawning population of 1,100 adult winter steelhead returning to the Hood River by 2019.

Obj. 2. Make 1,150 winter steelhead available for harvest in the Hood River subbasin.

Obj. 3. Retain the genetic integrity of wild winter steelhead in the Hood River subbasin.

Research Strategies

Strategy 1. Monitor harvest of Hood River stocks of summer and winter steelhead (*see* Coccoli 2004).

Null Hypothesis: The Hood River subbasin's numerical harvest objectives have not been achieved.
Alternative: The Hood River subbasin's numerical harvest objectives have been achieved

Metric: Status and trend monitoring of subbasin non-tribal harvest in the Hood River subbasin. Evaluates program relative to the performance indicators for **Summer steelhead** (**Objective 2**) and **Winter steelhead** (**Objective 2**).

Purpose: One objective of the HRPP is to "**provide in-basin sustainable harvest opportunities**" (Coccoli 2004). Consumptive recreational fisheries currently harvest summer and winter steelhead in the Hood River subbasin. Tribal fisheries are known to have historically existed in the subbasin, but there is no information to determine historical harvest rates. Run year specific estimates of non-tribal summer and winter steelhead harvest and exploitation rates in the Hood River subbasin are summarized for the 1996-2007 run years in Olsen (2008).

The HRPP's numerical harvest objectives were originally defined in the Hood River Subbasin Summary (Coccoli 2000) for summer and winter steelhead. The harvest objectives were revised downward in 2004 (*see* ODFW and CTWSRO Undated*b*), based on data collected on the Hood River subbasin's existing M&E project, and are defined in the Hood River Subbasin Plan (Coccoli 2004). The harvest objectives are currently defined in terms of making 1,100 summer steelhead and 1,150 winter steelhead available for harvest in both non-tribal and tribal fisheries within the Hood River subbasin.

Estimates of harvest and exploitation rates in the Hood River subbasin below Powerdale Dam will provide an empirical basis for determining if the non-tribal fishery limits or constrains the HRPP's ability to consistently achieve the numerical spawner escapement objectives for summer and winter steelhead (*see* **Strategy 2**). This data will also provide fisheries managers with the tools required to more effectively evaluate options for allocating subbasin harvest opportunities in a manner that ensures the subbasin's numerical spawner escapement objectives are met.

Harvest of Hood River stocks of summer and winter steelhead in the mainstem Columbia River has a direct impact on the HRPP's ability to achieve the subbasins numerical spawner escapement objectives. To protect threatened and endangered species of anadromous salmonids in the Lower Columbia River ESU (which includes the Hood River subbasin), the National Marine Fisheries Service (NMFS) establishes allowable take limits in mainstem Columbia River non-tribal and tribal fisheries. NMFS's proposed maximum allowable winter steelhead take limit for the years 2005-2007 are 6.0% in the non-Indian fishery and 10.7% in the treaty Indian fishery (NMFS 2005). The problem is that preliminary information would suggest the exploitation rate on winter steelhead in the Bonneville Pool alone likely exceeds 6% and could average as high as 17-18% (Rawding et al. 2005); well above NOAA fisheries proposed maximum incidental take limit for the years 2005-2007.

In addition to estimating harvest and exploitation rates in the mainstem Columbia River and the Hood River subbasin, creel surveys will be used to collect the biological information required to 1) evaluate the impact that subbasin fisheries have on selected life history patterns of returning wild, natural, and hatchery produced fish; 2) estimate wild, natural, and hatchery steelhead smolt-to-adult survival rates back to the mouth of the Hood River (i.e., in conjunction with estimates of escapement to adult collection facilities in the Hood River subbasin both pre- and post- Powerdale Dam (*see* **Strategy 2**); and 3) provide demographic information on non-tribal anglers.

Timeline: Ongoing

Methods: We propose conducting a creel which is primarily designed to collect the information needed to evaluate whether or not the HRPP is achieving its numerical harvest objectives. The proposed M&E project will estimate harvest in the non-tribal fishery located in the Hood River subbasin. The non-tribal fishery is currently restricted to the mainstem of the Hood River below River Mile (RM) 4.5; which is the site of Powerdale Dam. The potential exists that the non-tribal fishery may be extended beyond RM 4.5, upon removal of Powerdale Dam. Methods for implementing the creel program will require more effort if the fishery is expanded beyond its current boundaries, but the methodologies for estimating non-tribal harvest in the Hood River subbasin would remain un-changed. The methodologies for implementing the creel, and for estimating harvest, are detailed in Olsen (2008).

We are proposing to PIT tag downstream migrant wild and hatchery summer and winter steelhead smolts (*see* **Strategy 3**) in order to implement a mark and recapture program on returning PIT tagged adults. This effort is primarily designed to 1) collect the empirical information required to refine estimates of harvest and exploitation rates of winter steelhead in the Bonneville Pool, 2) monitor run timing of lower Columbia River steelhead through the spring fishery below Bonneville Dam, and 3) provide a mechanism for estimating escapements to the mouth of the Hood River post- Powerdale Dam (*see* **Strategy 2**).

Strategy 2. Monitor spawner escapements of wild and hatchery summer and winter steelhead to the Hood River subbasin (*see* Coccoli 2004).

Null Hypothesis 1: The Hood River subbasin's numerical spawner escapement objectives have not been achieved.
Alternative 1: The Hood River subbasin's numerical spawner escapement objectives have been achieved.
Null Hypothesis 2: Habitat improvement work conducted in the Hood River subbasin has significantly increased the subbasins spawner carrying capacity.
Alternative 2: Habitat improvement work conducted in the Hood River subbasin has not significantly increased the subbasins spawner carrying capacity.

Metric: Status and trend monitoring of spawner escapements to the Hood River subbasin. Evaluates program relative to the performance indicators for **Summer steelhead** (**Objective 1**) and **Winter steelhead** (**Objective 1**).

Purpose: One objective of the HRPP is "**to increase production of wild summer and winter steelhead (*Oncorhynchus mykiss*) commensurate with the subbasins current carrying capacity**" (Coccoli 2004). The HRPP's numerical spawner escapement objectives were originally defined in the Hood River Subbasin Summary (Coccoli 2000) for summer and winter steelhead. The spawner escapement objectives were revised downward in 2004 (*see* ODFW and CTWSRO Undated*b*), based on data collected on the Hood River subbasins existing M&E project, and are defined in the Hood River Subbasin Plan (Coccoli 2004) as follows: 1) to achieve and maintain an average annual spawner escapement of 600 wild adult summer steelhead and 2) to achieve and maintain an average annual spawner escapement of 1,100 wild adult winter steelhead. Run year specific estimates of summer and winter steelhead spawner escapements to the Hood River subbasin are summarized for the 1991-1992 through 2006-2007 run years in Olsen (2008).

The HRPP's numerical spawner escapement objectives are based on the prevailing hypothesis that subbasin spawner escapements are currently below the level needed to fully seed the subbasin (*see* **Strategy 3**), and that habitat improvement projects will significantly increase the subbasins potential carrying capacity. Fishery managers consider the information required to reject or accept these hypothesis as critically important in refining the approach ultimately taken to implement the HRPP over the time frame of the Hood River Subbasin Plan (Coccoli 2004). The approach currently taken to achieve the HRPP's numerically defined spawner escapement objectives has been to

1) restrict harvest of unmarked summer and winter steelhead and 2) supplement the Hood River subbasin with Hood River stock hatchery summer and winter steelhead.

The HRPP's existing M&E project is just beginning to collect the complete juvenile and adult life history information required to accept or reject **Hypothesis 1**. Maintaining and expanding on the existing data string is considered particularly important in light of the subbasins anticipated response to 1) proposed changes in guidelines for implementing the hatchery supplementation component of the HRPP, 2) several large scale habitat improvement projects (i.e., both proposed and implemented), and 3) the de-commissioning and removal of Powerdale Dam.

Timeline: Ongoing

Methods: We propose monitoring adult spawner escapements at adult collection facilities located in the Hood River subbasin both pre- and post- Powerdale Dam. The existing adult collection facility at Powerdale Dam is located at RM 4.5 in the mainstem Hood River and traps virtually all anadromous salmonids escaping to spawning grounds located in the Hood River subbasin. The proposed collection facilities post- Powerdale Dam are not expected to sample all summer and winter steelhead escaping to the available spawning grounds in the Hood River subbasin. We are initially proposing to develop a rough estimate of the percentage wild and hatchery steelhead that will not actively migrate past the post- Powerdale Dam adult collection facilities. The estimate will based on the ratio between the counts of adult steelhead at Powerdale Dam and counts of adult steelhead at the proposed post- Powerdale Dam adult collection facilities. This task will only be possible if the proposed post- Powerdale Dam adult collection facilities are fully on line prior to removal of Powerdale Dam. The ratio would be applied to counts at the post- Powerdale Dam adult collection facilities to estimate escapement to the mouth of the Hood River post- Powerdale Dam; in conjunction with subbasin harvest estimates (*see* **Strategy 1**). We are also in the very preliminary stages of looking at various models that might have the potential for estimating wild steelhead escapements to the mouth of the Hood River. These models will be based on a combination of variables that have been extensively monitored during the course of the HRPP's existing M&E project. These include 1) summer stream flows (*see* **Strategy 6**), 2) the relationship between subbasin smolt production and summer stream flows, 3) the relationship between smolt-to-adult survival rates of wild and hatchery steelhead, and 4) the estimated PIT tagged:non PIT tagged ratio in the estimate of subbasin smolt production and in adult returns back to Powerdale Dam. The methodologies and guidelines for sampling, handling, identifying, and distributing wild and hatchery adult summer and winter steelhead collected at adult collection facilities post- Powerdale Dam will likely remain unchanged from those outlined for Powerdale Dam in Olsen (2008).

Strategy 3. Monitor production of wild steelhead in the Hood River subbasin (*see* Coccoli 2004).

Null Hypothesis: Post- HRPP implementation smolt production is significantly greater than pre- project implementation.

Alternative: Post- HRPP implementation smolt production is not significantly greater than pre- project implementation.

Metric: Status and trend monitoring of steelhead smolt production in the Hood River subbasin. Evaluates program relative to the performance indicators for **Summer steelhead** (**Objectives 1 and 3**) and **Winter steelhead** (**Objective 1**).

Purpose: One objective of the HRPP is "**to increase production of wild summer and winter steelhead (*Oncorhynchus mykiss*) commensurate with the subbasins current carrying capacity**" (Coccoli 2004). Subbasin smolt production objectives for the HRPP are defined for summer steelhead in Coccoli (2004). This strategy is inextricably linked with the HRPP's numerical fish objectives for subbasin spawner escapement (*see* **Strategy 2**). The HRPP's defined smolt production and spawner escapement objectives for summer and winter steelhead are implicitly based on two general hypotheses: 1) that the Hood River subbasin is under seeded in terms of both smolt and spawner carrying capacities and 2) habitat improvement work will significantly increase the subbasins carrying capacity relative to both smolts and spawners.

The numerical fish objectives for wild and hatchery harvest (*see* **Strategy 1**) and subbasin spawner escapements (*see* **Strategy 2**) are currently based on wild and hatchery steelhead egg-to-smolt and smolt-to-adult survival rates that were estimated on the HRPP's existing M&E project. Harvest/take in the mainstem Columbia River (i.e., Bonneville Pool) is currently based on preliminary estimates provided in Rawding et al. (2005). Continued refinement of wild and hatchery smolt-to-adult survival rates, as they respond to both in-basin and regional efforts to increase adult returns to the Hood River subbasin, is considered critical to implementing the HRPP in a biologically sound and economically efficient manner. Also, preliminary data from the HRPP's existing M&E project would suggest that removal of Powerdale Dam will significantly increase the smolt-to-adult survival rate for both wild and hatchery smolts. Accurately determining the degree of change will provide the basis for fishery managers to re-assess the level of hatchery supplementation required to achieve the HRPP's numerical fish objectives. Data collected under this strategy will provide the basis for estimating 1) egg-to-smolt and smolt-to-adult survival rates for wild steelhead, 2) incidental catch of steelhead in spring fisheries below Bonneville Dam, and 3) steelhead harvest in the Bonneville Pool. The latter two parameters will be evaluated from returning PIT tagged adult steelhead.

The HRPP's existing M&E project has annually conducted a mark and recapture program designed to estimate Hood River subbasin steelhead smolt production (*see* Olsen 2008). Estimates are available for the 1994-2007 years of migration. Annual estimates were used to refine the HRPP's initial numerical fish objectives for steelhead spawner escapement; as defined during the early planning and implementation stages of the HRPP (*see* **Strategy 2**). Fishery managers consider implementation of this strategy of the M&E program to be highly critical given the fact that it is anticipated that subbasin carrying capacity will increase as a consequence of 1) revised changes in guidelines for implementing the hatchery supplementation component of the HRPP, 2) implementation of proposed habitat improvement projects, and 3) de-licensing and removal of Powerdale Dam. Information gathered from the continued monitoring of subbasin smolt production will be used to 1) further refine the HRPP's numerical fish objectives for spawner escapement (*see* **Strategy 2**) and 2) further refine the approach for implementing the HRPP's hatchery supplementation program. These refinements will occur as subbasin carrying capacity increases in response to those actions implemented by the HRPP to increase the Hood River subbasin's carrying capacity.

Results from the HRPP's existing M&E program suggest that we should be able to observe/quantify the subbasins response to selected large habitat improvement projects, by monitoring subbasin steelhead smolt production. Migrant traps have been operated as part of the HRPP's existing M&E project, and they have proven to be an effective tool for both estimating subbasin steelhead production and for PIT tagging downstream migrant steelhead. Historically, the downstream migrant traps have been able to capture and mark 3-7% of the estimated steelhead smolt production within the subbasin (Olsen, 2007). Confidence limits (95%) at the mainstem migrant trap, with few exceptions, are fairly tight; having a range of plus or minus 21-38% for the years 1996-2000 and 2002-2006 (Olsen 2007).

Another focus of efforts to estimate subbasin smolt production is to determine if models can be developed to estimate subbasin steelhead smolt production from other more easily and cheaply monitored variables. Initial modeling efforts indicate that subbasin steelhead smolt production and summer flow are positively correlated (i.e., R^2 greater than 0.58). Preliminary analysis suggests that incorporating data on spawner escapements and snow pack into the model will increase the R^2 to around 0.8.

Our initial modeling efforts for genetically identifying summer and winter steelhead show "**evidence of variation in allele frequencies and significant genetic differentiation**" (Matala et al. 2005). We are currently using these models to exclude mis-identified adult summer and winter steelhead from the hatchery broodstock. The models were developed, and are annually refined, from tissue samples collected from downstream migrant steelhead smolts collected from known populations of summer and winter steelhead. Fisheries managers have given this component of the M&E program very high priority. This is based on the fact that data from the HRPP's existing M&E project indicates current hatchery broodstock selection protocols, which use selected phenotypic cues to determine race, are inadequate to effectively prevent summer and winter races of steelhead from being visually mis-identified and incorporated into the wrong broodstock.

Timeline: Ongoing

Methods: The primary focus of this strategy will be to operate and maintain downstream migrant screwtraps at selected sites located in the mainstem Hood River; West, Middle, and East forks of the Hood River; and in Lake Branch, a tributary to the West Fork of the Hood River. Sampling sites will be established in areas designed to optimize the number of migrants sampled from both populations of summer and winter steelhead, but consideration will be given to locating traps in areas where opportunities will exist to sample and mark bull trout, cutthroat trout, and spring Chinook salmon. The migrant traps will be used to enumerate, bio-sample, and PIT tag downstream migrant salmonids and to collect genetic samples from downstream migrant rb-st. Historically, trapping sites have allowed us to annually capture and mark from 2.7 to 7.3% of the subbasin's steelhead smolt production (Olsen 2007).

The migrant traps will be instrumental in providing a mechanism for 1) estimating and monitoring subbasin steelhead smolt production, 2) genetically assigning summer and winter steelhead for hatchery broodstock, and 3) estimate winter steelhead harvest in the Bonneville Pool. Estimates of smolt production will be used to develop models that will 1) predict annual subbasin steelhead smolt production from selected physical and environmental factors specific to the Hood River subbasin (*see* **Strategy 6**) and 2) predict future run sizes of summer and winter steelhead (i.e., in conjunction with adult counts at collection facilities both pre- and post- Powerdale Dam [*see* **Strategy 2**]). Estimates of smolt production will also be used to monitor the subbasins response to selected habitat improvement work/projects relative to subbasin smolt production. The primary contractor for doing the broodstock identification work will be the USFWS out of the Conservation Genetics Lab at the Abernathy Fish Technology Center. PIT tag detection information at Bonneville Dam is available through the Pacific States Marine Fisheries Commission (PSMFC) Columbia River DART (Data Access in Real Time) PIT tag reporting website (i.e., http://www.cbr.washington.edu/dart/pit_obs_de.html). Sampling methods and data analysis are extensively outlined in 1) Olsen (2008) for estimating smolt production at the downstream migrant traps, 2) Matala et al. (2005) for the broodstock identification project, 3) Olsen (2008) for estimating subbasin smolt production based on summer flows, and 4) Olsen (2008) for PIT tagging steelhead smolts.

WDFW's initial efforts to estimate harvest in the Bonneville Pool based on floy tagged adult steelhead (i.e., marked adults) at Bonneville Dam, and recovered at selected sites above Bonneville Dam, was very effective (Rawding et al. 2005). Confidence limits (97.5%) on the estimate of exploitation rates in the Bonneville Pool fell within minus 67% to plus 105% (Rawding et al. 2005). Instead of floy tagging adult steelhead at Bonneville Dam, this strategy proposes implementing tasks designed to allow PIT tag detections at Bonneville Dam to be used as the sample of marked fish, and the adult collection facilities in the Hood River subbasin as the recovery sites for both marked and unmarked Hood River stock wild and hatchery adult steelhead. The HRPP's existing M&E project PIT tagged 1,983 downstream migrant wild steelhead smolts in 2005 (i.e., ~6.5% of the subbasin production), and approximately 2,000 hatchery summer steelhead and 2,000 hatchery winter steelhead in 2005. Additionally, the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO) PIT tagged approximately 5,000 hatchery winter steelhead in 2005. We anticipate the first significant returns of PIT tagged wild and hatchery steelhead beginning with the return of 2 salt adult winter steelhead in the 2006-2007 run year. We are currently in the process of determining the feasibility of estimating winter steelhead harvest in the Bonneville Pool from PIT tagged wild and hatchery steelhead.

Strategy 4. Monitor selected life history and phenotypic characteristics of juvenile and adult wild and hatchery steelhead in the Hood River subbasin (*see* Coccoli 2004).

Null Hypothesis 1: Selected life history and phenotypic characteristics of wild and hatchery populations of summer and winter steelhead in the Hood River subbasin are not significantly different post- implementation of the HRPP.

Alternative 1: Selected life history and phenotypic characteristics of wild and hatchery populations of summer and winter steelhead in the Hood River subbasin are significantly different post- implementation of the HRPP.
Null Hypothesis 2: The spatial distribution of naturally spawning hatchery adult winter steelhead can be significantly expanded by distributing hatchery production releases over a wide geographic range.
Alternative 2: The spatial distribution of naturally spawning hatchery adult winter steelhead cannot be significantly expanded by distributing hatchery production releases over a wide geographic range.

Metric: Status and trend monitoring of selected life history and phenotypic characteristics of juvenile and adult summer and winter steelhead in the Hood River subbasin. Evaluates program relative to the performance indicators for **Summer steelhead** (**Objective 4**) and **Winter steelhead** (**Objective 3**).

Purpose: The Northwest Power Planning Council (NPPC) expressed a concern that the HRPP should be designed and implemented in a manner that minimized any negative impact the program might have on indigenous populations of fish in the Hood River subbasin. As a consequence, the hatchery supplementation component of the HRPP was designed within the context of achieving two basic principles: 1) to produce a hatchery product that would be both biologically and genetically suited to the Hood River subbasin and 2) that all actions implemented under the umbrella of the HRPP would have a minimal negative impact on indigenous populations of fish. Preliminary data collected from the HRPP's existing M&E project indicates that specific management decisions may have resulted in 1) a shift in the run timing of wild and Hood River stock hatchery runs of summer and winter steelhead, 2) the cross breeding of summer and winter steelhead in the hatchery broodstock, 3) a reduction in the genetic fitness of indigenous populations of summer and winter steelhead, and 4) a returning hatchery adult winter steelhead that spawns over a narrow geographic range. Several of the above problems occurred as an unintended consequence of ongoing activities related to the operational guidelines established for implementing the hatchery supplementation component of the HRPP, but more importantly the HRPP's existing M&E project provided data that identified these problems during the early stages of implementation. As a consequence, fishery managers were able to use the data in the early implementation stages of the HRPP to develop biologically sound measures for correcting the problems.

The HRPP's existing M&E program continues to provide a comprehensive data set that can be used to 1) monitor the interaction of wild and hatchery (i.e., both indigenous and non-indigenous stocks) components of the summer and winter runs of steelhead, 2) evaluate the reproductive success of the Hood River stock of hatchery summer and winter steelhead relative to the indigenous wild stocks of summer and winter steelhead, and 3) evaluate and compare selected life history and phenotypic characteristics of wild and hatchery steelhead. Without the HRPP's existing M&E program, it is doubtful that fishery managers would have been able to identify any of the potential negative impacts the HRPP might have had on indigenous populations of steelhead; let alone to have identified the problems early on in the implementation phase of the HRPP. Also, there would have been no empirical data available for fishery managers to use in developing biologically sound corrective measures. The Hood River subbasins fishery co-managers consider the on-going collection of bio-data on the HRPP's target species as critical to implementing the HRPP in a biologically sound manner (Coccoli 2004).

Timeline: Ongoing

Methods: The adult collection facility at Powerdale Dam (PD) has been the cornerstone for providing information critical to monitoring several key biological parameters for wild and hatchery stocks of steelhead in the Hood River subbasin. More importantly, it provides the means for both counting and bio-sampling virtually <u>all</u> adult steelhead that will eventually spawn in the Hood River subbasin. The biological and genetic information gathered at PD provides a mechanism for accurately estimating in-basin 1) smolt-to-adult survival rates (i.e., in conjunction with data from the migrant traps [*see* **Strategy 3**]), 2) escapements to the mouth of the Hood River (i.e., in conjunction with data from the creel [*see* **Strategy 1**]), 3) adult run timing, 4) adult straying rates, 5) exploitation rates in the non-tribal fishery (i.e., in conjunction with data from the creel [*see* **Strategy 1**]), and 5) reproductive success of both indigenous and non-indigenous stocks of steelhead that spawn in the subbasin (*see* **Strategy 5**). Post- Powerdale Dam it is unlikely that we will be able to achieve the sampling rate that exists under the current program. As a consequence, the proposed M&E program will be confined to monitoring selected life history and phenotypic characteristics from only those steelhead escaping to the post- Powerdale Dam adult collection facilities. it is believed, however, that the greater percentage of wild and Hood River stock hatchery adult summer and winter escaping to spawn in the Hood River subbasin will be trapped at the proposed post- Powerdale Dam adult collection facilities. The large sample sizes that are anticipated should allow us to accurately test this strategies null hypothesis; in conjunction with data collected in the Hood River creel (*see* **Strategy 1**). The methodologies for sampling and analyzing data should remain unchanged and are extensively outlined in Olsen (2008).

Additional bio-sampling will occur in 1) non-tribal fisheries (*see* **Strategy 1**) and 2) at juvenile migrant traps (*see* **Strategy 3**). We also propose 1) monitoring the spatial distribution of wild and hatchery spawners and 2) collecting and summarizing regional count and bio-data on steelhead that were PIT tagged as juveniles in the Hood River subbasin. Columbia River Basin PIT tag detection information is available through the PSMFC's Columbia River DART (Data Access in Real Time) PIT tag reporting website (i.e., http://www.cbr.washington.edu/dart/pit_obs_de.html). Information will be used to 1) gather both in-basin and out-of-basin life history and incidental catch (i.e., in the mainstem Columbia River) information and 2) propose and develop strategies designed to optimize the benefits associated with implementation of the HRPP.

An experimental group of PIT tagged hatchery winter steelhead smolts will be direct released into the upper East Fork (EFK) of the Hood River subbasin (i.e., approximately RM 17) to determine if returning adults will have a greater likelihood of spawning in the upper drainage. The control group will be represented by PIT tagged hatchery smolts that were acclimated and released at existing facilities located in the lower EFK of the Hood River (i.e., approximately RM 6.5). Returning adults will be sampled at adult collection facilities located in the subbasin and both experimental and control groups of adult hatchery winter steelhead will be identified based on PIT tags. A radio tag will be inserted into a random sample from both the experimental and control groups of winter steelhead. Radio tagged adults will then be monitored with fixed stations, and on foot, to determine location of spawning.

Strategy 5. Monitor population genetic structure, systematics, and distribution of steelhead, cutthroat, and resident rainbow trout populations indigenous to the Hood River subbasin (*see* Coccoli 2004).

Null Hypothesis 1: The long-term fitness of wild populations of summer and winter steelhead in the Hood River subbasin is significantly reduced as a consequence of supplementing the subbasin with Hood River stock hatchery summer and winter steelhead.

Alternative 1: The long-term fitness of wild populations of summer and winter steelhead in the Hood River subbasin is not significantly reduced as a consequence of supplementing the subbasin with Hood River stock hatchery summer and winter steelhead.
Null Hypothesis 2: The reproductive success of naturally spawning Hood River stock hatchery summer and winter steelhead significantly differs from the reproductive success of the naturally spawning wild populations.
Alternative 2: The reproductive success of naturally spawning Hood River stock hatchery summer and winter steelhead does not significantly differ from the reproductive success of the naturally spawning wild populations.
Null Hypothesis 3: Wild and Hood River stock hatchery summer and winter steelhead smolts have significantly different smolt-to-adult survival rates (i.e., to the mouth of the Hood River).
Alternative 3: Wild and Hood River stock hatchery summer and winter steelhead smolts do not have significantly different smolt-to-adult survival rates (i.e., to the mouth of the Hood River).

Metric: Status and trend monitoring of the genetic fitness of naturally spawning summer and winter steelhead in the Hood River subbasin. Evaluates program relative to the performance indicators for **Summer steelhead** (**Objective 4**) and **Winter steelhead** (**Objective 3**).

Purpose: State and federal agencies have established laws and guidelines that identify measures for protecting populations of anadromous salmonids and resident trout. Implementation of these measures in the Hood River subbasin is problematic given the lack of any historical information to indicate where reproductively isolated populations exist. For some species, the Hood River subbasin is on the boundary between subspecies, and the taxonomic designation is uncertain.

There are several species of anadromous and resident salmonids indigenous to the Hood River subbasin. They include summer and winter steelhead, spring and fall Chinook, coho salmon, rainbow/redband trout, cutthroat and bull trout, and mountain whitefish. We propose focusing genetic studies on populations of steelhead, rainbow/redband trout, and cutthroat trout. We currently do not propose investigating the bull trout population because the required level of sampling may detrimentally impact the wild population, and we do not propose investigating the naturally produced population of spring Chinook salmon because it is believed the indigenous population is functionally extinct. We do not propose sampling for coho or fall Chinook salmon at this time, but may propose analyzing existing genetic samples, and collecting additional genetic samples in the future, if a review of existing allozyme data indicates that sampling is warranted. There are currently no plans to study mountain whitefish.

The Hood River subbasin is geographically located on the boundary between two subspecies of *Oncorhynchus mykiss*. They include *Oncorhynchus mykiss irideus* (coastal rainbow/steelhead) and *Oncorhynchus mykiss gairdneri* (Columbia River redband/steelhead). The identity of the *O. mykiss* subspecies native to the Hood River subbasin is unknown.

The Hood River subbasin and the adjacent Fifteenmile Creek subbasin are thought to be the most inland Columbia River subbasins containing the coastal cutthroat (*O. clarki clarki*). It is alternatively conceivable that the Hood River subbasin contains members of the Westslope Cutthroat (*O. clarki lewisi*), which is found in the John Day River subbasin. Consequently, because of the uncertainty in *O. clarki* taxonomy two alternative hypothesis exist: 1) *O. clarki* may be a natural hybrid of two of the species or 2) *O. clarki* may be an artificial hybrid caused by past hatchery programs. For the above reasons, the identity of the *O. clarki* subspecies native to the Hood River subbasin warrants investigation.

We propose collecting tissue samples from downstream migrant 1) steelhead, 2) cutthroat trout, and 3) resident trout (*see* **Strategy 3**) and upstream migrant adult summer and winter steelhead (*see* **Strategies 2** and **4**). Tissue samples will be collected from these populations to evaluate the risks associated with introgression within species, and hybridization between species, of wild and hatchery populations. Some subspecies of *O. mykiss* and *O. clarki* are naturally sympatric without cross species hybridization. Other subspecies, including coastal rainbow and some inland cutthroat subspecies, readily hybridize and then introgress when artificially brought into contact as a result of hatchery supplementation programs. Hybrid zones do occur naturally along the boundary of some species and subspecies. Hybridization caused by the introduction of hatchery produced fish is considered to pose a significant risk to the wild population.

We propose studying both the migratory and resident life history patterns of both *O. mykiss* and *O. clarki* and also the resident trout of uncertain taxonomic status discussed above. Both species will be studied because of the potential for interbreeding between both the wild and hatchery fish. Interbreeding between resident trout and anadromous life histories of *O. mykiss* appears to occur naturally in the subbasin. Direct interbreeding between resident and anadromous populations is rarely observed (generally involving resident males interbreeding with steelhead females) but both steelhead and resident trout life history patterns are thought to produce offspring with the alternative life history pattern; thus facilitating gene flow between both populations. Therefore, both the resident and migratory life history types of *O. mykiss* need to be studied.

The Hood River subbasin's fishery co-managers consider it critically important to monitor, at a genetic level, the interaction between wild and hatchery populations of steelhead. Primarily because of the potential for a high degree interbreeding that may occur between wild and hatchery populations of steelhead and wild populations for resident rainbow and cutthroat trout. Information gathered under the umbrella of this strategy will provide the basis for developing and refining hatchery guidelines for the HRPP in a manner that will provide the greatest degree of protection for indigenous populations of *O. mykiss* in the Hood River subbasin. It is also anticipated that data collected under this strategy, when combined with information collected on the HRPP's existing M&E project, will have much broader regional application when developing and implementing biologically sound hatchery supplementation programs in other subbasins.

Timeline: Ongoing

Methods: The adult collection facility at Powerdale Dam (PD) has been the cornerstone for providing information critical to monitoring the genetic fitness of wild and hatchery stocks of steelhead in the Hood River subbasin. It has provided biologists the means for counting, bio-sampling, and collecting genetic samples from virtually all adult steelhead that will eventually spawn in the Hood River subbasin. The ability to sample virtually the entire spawning populations of wild and hatchery steelhead in the Hood River subbasin has greatly enhanced our ability to evaluate and monitor the reproductive success of several generations of steelhead in the Hood River subbasin.

Genetic samples were first collected from wild and hatchery winter steelhead beginning with the 1991-1992 run year, and from wild and hatchery summer steelhead beginning with the 1992-1993 run year. Virtually all adult steelhead were sampled through the 2007 calendar year, and this policy will continue until the existing adult collection facilities are shut down upon removal of Powerdale Dam. Post- Powerdale Dam it is unlikely that we will be able to achieve the sampling rate that exists under the current program. As a consequence, the M&E program will be confined to collecting tissue samples from only those steelhead escaping to the post- Powerdale Dam adult collection facilities. It is believed, however, that the greater percentage of wild and Hood River stock hatchery adult summer and winter steelhead escaping to spawn in the Hood River subbasin will be trapped at the proposed post- Powerdale Dam adult collection facilities. The large sample sizes that are anticipated should allow us to accurately test this strategies null hypotheses; in conjunction with data collected in the Hood River creel (*see* **Strategy 1**). Sampling methods and data management protocols should remain unchanged and are extensively outlined in Olsen (2008). Tissue samples collected from both downstream migrant rb-st (*see* **Strategy 3** and **4**) and upstream migrant adults will be genetically analyzed, evaluated, and summarized based on principles and methodologies that are extensively outlined in Araki and Blouin (2005), Blouin and Araki (2004), Blouin and Araki (2005), Blouin and Araki (2006), Araki et al. (2007*a*), Araki et al. (2007*b*), and Araki et al. (2007*c*).

Strategy 6. Monitor selected physical and environmental constraints that have the potential for limiting wild and natural production of anadromous salmonids in the Hood River (*see* Coccoli 2004).

Null Hypothesis 1: Habitat improvement work conducted in the Hood River subbasin significantly increases subbasin carrying capacity.

Alternative 1: Habitat improvement work conducted in the Hood River subbasin does not significantly increase subbasin carrying capacity.
Null Hypothesis 2: Existing and proposed habitat improvement projects define strategies and tasks that have the potential for significantly improving subbasin carrying capacity.
Alternative 2: Existing and proposed habitat improvement projects define strategies and tasks that do not have the potential for significantly improving subbasin carrying capacity.

Metric: Status and trend monitoring of various physical and environmental constraints limiting the Hood River subbasin current and potential carrying capacity for populations of summer and winter steelhead. Evaluates program relative to the performance indicators for **Summer steelhead** (**Objectives 1 and 3**) and **Winter steelhead** (**Objective 1**).

Purpose: Carrying capacity for the Hood River subbasin is currently estimated based on two computer models: 1) the Unit Characteristic Method (UCM) model and 2) the Ecosystem Diagnosis and Treatment (EDT) model. Output from both models was derived from subbasin specific physical; environmental; and species, race and stock specific biological data collected from the HRPP's existing M&E project. Information provided in the modeling efforts should include at a minimum the following empirical data on:
1) annual estimates of subbasin juvenile and adult steelhead production (*see* **Strategies 1-3**); 2) selected life history and phenotypic characteristics of indigenous populations of steelhead (*see* **Strategy 4**); 3) the quantity, quality, and diversity of available habitat in the subbasin; 4) summer and winter flows at selected sites in the subbasin, 5) seasonal variations in water temperatures at selected sites in the subbasin, and 6) rearing densities as selected sites in the subbasin. It should also be noted that none of the data used in the modeling efforts should be treated as static. Habitat improvement work, proposed under the umbrella of the HRPP, is designed to increase subbasin carrying capacity. The EDT model provides the basis for evaluating the percent change in subbasin carrying capacity that might be anticipated from the proposed habitat improvement projects, but both the UCM and EDT models would lack the empirical data required to accurately quantify the numerical increase in salmonid production that occurs in response to the proposed habitat improvement work. Fishery managers consider it critically important to monitor both the individual and cumulative benefits of each project, and that the evaluation takes into consideration other land management activities in the drainage that may have the potential for reducing project benefits. Information gathered under this strategy will provide the basis for proposing the most effective strategies for improving habitat in the subbasin, and will provide the empirical data required to evaluate each project relative to the projects stated benefits.

Timeline: Ongoing

Methods: Tasks implemented under this strategy would be designed to monitor various physical and environmental parameters that have the greatest potential for limiting steelhead carrying capacity in the Hood River subbasin. Specific tasks would include, but not necessarily be limited to, the monitoring of seasonal variation in 1) stream flow, 2) stream temperatures, 3) rearing densities, and 4) the quality and quantity of specific habitat types. Methodologies are defined in Olsen (2008) for estimating stream flow and in Olsen et al. (1996) for estimating both rearing densities and selected in-stream physical parameters.

Strategy 7. Monitor indigenous populations of redband/rainbow, cutthroat, and bull trout in the Hood River subbasin (*see* Coccoli 2004).

Null Hypothesis 1: The long-term fitness of indigenous populations of redband/rainbow, cutthroat, and bull trout in the Hood River subbasin is significantly reduced as a consequence of supplementing the subbasin with Hood River stock hatchery summer and winter steelhead.
Alternative 1: The long-term fitness of indigenous populations of redband/rainbow, cutthroat, and bull trout in the Hood River subbasin is not significantly reduced as a consequence of supplementing the subbasin with Hood River stock hatchery summer and winter steelhead.

Metric: Status and trend monitoring of indigenous populations redband/rainbow, cutthroat, and bull trout in the Hood River subbasin. Evaluates program relative to the performance indicators for **Summer steelhead** (**Objective 4**) and **Winter steelhead** (**Objective 3**).

Purpose: The hatchery supplementation component of the HRPP has the potential for negatively impacting species of resident and anadromous salmonids in the Hood River subbasin that are not the main target of the program. Non- target indigenous populations of salmonids that are of critical concern include rainbow/redband trout, cutthroat trout, and bull trout. Limited information is available to characterize the status of these populations. It is difficult to either quantify or qualify the potential risks the HRPP may pose to these populations, primarily because biological systems are highly complex in nature and are not completely understood. However, hatchery summer and winter steelhead can hybridize with indigenous populations of wild steelhead and rainbow trout (*see* **Strategy 5**) and the potential exists to reduce the reproductive success of resident populations of trout.

The Hood River subbasins fishery co-managers consider some level of population monitoring as critically important for developing biologically sound guidelines that will minimize any negative impacts the HRPP may have on populations of rainbow/redband trout, cutthroat trout, and bull trout. A considerable amount of population, biological, and genetic data relative to these indigenous species can be collected in association with activities outlined in **Strategies 1-5**; strategies which are primarily intended to collect information on the HRPP's target species.

Timeline: Ongoing.

Methods: We propose monitoring the above populations by way of 1) counting (i.e., relative abundance), bio-sampling, and PIT tagging migrants caught at downstream migrant traps (*see* **Strategy 3**); 2) counting and bio-sampling species caught in the Hood River creel (*see* **Strategy 1**); 3) counting, bio-sampling, and PIT tagging upstream migrants caught in adult collection facilities located in the Hood River subbasin both pre- and post- Powerdale Dam (*see* **Strategies 2** and **4**), and 4) collecting tissue samples from juvenile and adult redband/rainbow, cutthroat, and bull trout (*see* **Strategy 5**). The methodologies for sampling and analyzing data, other than those associated with the genetic analysis of tissue samples, are extensively outlined in Olsen (2008). The methodologies for analyzing tissue samples have not as yet been established for redband/rainbow, cutthroat, and bull trout.

11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.
The Monitoring and Evaluation (M&E; i.e., research) component of the Hood River Production Program is currently funded entirely by the Bonneville Power Administration, as a component of the HRPP.

11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.

Juvenile Trapping
Migrant traps are sampled daily to minimize mortality associated with trapping stress. Pre-smolt and smolt salmonids collected for bio-sampling are held in water oxygenated with a portable aerator when large numbers of downstream migrants are caught in the trap. The live box on the mainstem migrant trap was also modified from its original dimensions in order to further minimize stress-related mortality associated with the trapping of downstream migrants. The live box was enlarged by about 80%; a side compartment was added to provide some separation of migrants in the live box and to provide an area of reduced turbulence. The number of downstream migrant wild and hatchery steelhead and resident rainbow trout that are marked and released above the trap, to estimate recapture rates at the migrant traps, is limited to a relatively small percentage of the total number caught. This is done to minimize handling mortality.

Adult Trapping
The proposed trapping facility will be operated seven days a week to minimize holding stress, delay, potential for injury, or mortality. The trapping facility will be designed in a manner that minimizes stress-related mortality associated with the handling of fish for counting and bio sampling and complies with NOAA Fisheries and ODFW trap construction and operational guidelines. Fish released upstream from the trap, will be released to calm holding water where they will be allowed to recover. On site employees will guard against vandalism, or other contingencies, such as floods or equipment failures. Hatchery fish “recycled” through the fishery will be individually marked to determine if straying to other river systems occurs.

Harvest Estimates
The creel is conducted throughout the entire year to estimate harvest in the fishery located below Powerdale Dam. There are no risk aversion protocols associated with implementing the creel program.

SECTION 12. RESEARCH

12.1) Objective or purpose.

The research component of the HRPP provides funding to monitor and evaluate the various actions taken by the five other BPA funded projects collectively involved in implementing the HRPP. Information gathered from the monitoring and evaluation projects will be used to evaluate the HRPP relative to the programs performance goals and to provide information critical to implementing the program in a biologically sound manner. More specifically, the research component of the HRPP will provide the quantitative data critically needed by fishery managers to 1) determine if the biological fish objectives for the HRPP have been achieved, or are achievable and 2) optimize the benefits associated with the HRPP, and 3) minimize the HRPP's impact on ESA listed species (and other indigenous populations of fish) in the Hood River subbasin.

12.2) Cooperating and funding agencies.

The research component of the HRPP is entirely funded by Bonneville Power Administration and the HRPP is a cooperative program with the Confederated Tribes of the Warm Springs Reservation of Oregon.

12.3) Principle investigator or project supervisor and staff

Principal investigators for the Oregon Department of Fish and Wildlife are Erik Olsen (erik.a.olsen@state.or.us) and Robert Reagan. (robert.e.reagan@state.or.us).

12.4) Status of stock, particularly the group affected by project, if different than the stock(s) described in Section 2.

Stock status is the same as described in Section 2.

12.5) Techniques: include capture methods, drugs, samples collected, tags applied.

METHODS

Juvenile Trapping: Downstream migrant anadromous salmonids were trapped at rotary-screw traps (i.e., migrant trap) located in the mainstem Hood River (RM 4.5); in the West (RM 4.0), Middle (RM 1.3), and East (RM 1.0) forks of the Hood River; and in Lake Branch (RM 0.1), which is a tributary to the West Fork of the Hood River (Figure 3). Migrant traps were located at sites that would maximize both the flow into the trap and the amount of stream the trap would fish. Because of seasonal variation in stream flow, traps were periodically repositioned in the stream channel in order to optimize trapping efficiency. Migrant traps were fished seven days a week with the following two exceptions: 1) migrant traps located in the West, Middle, and East forks of the Hood River were pulled for 2-5 days following the two primary releases of each production group of hatchery salmon and steelhead smolts and 2) migrant traps subject to high flow events were pulled for 1-3 days following the event. The mainstem migrant trap fished to a maximum depth of 1.2 meters. Migrant traps in the West, Middle, and East forks of the Hood River, and in Lake Branch fished to a maximum depth of 0.8 meters. The migrant traps fished approximately 8%, 9%, 16%, 14%, and 20% of the stream channels width in the mainstem, West Fork (WFk), Middle Fork (MFk), East Fork (EFk), and Lake Branch, respectively.

The rotary-screw traps funneled downstream migrants into a live box that was sampled on a daily basis. Sampling was usually conducted in the morning to reduce temperature related stress. All fish were anesthetized with MS 222 (Tricaine Methanesulfonate), sorted by species, examined for fin and maxillary mark combinations, and counted. Counts of downstream migrant rainbow-steelhead (rb-st), cutthroat trout, and bull trout were made for two size categories; they included fish greater than or equal to 150 mm fork length and fish less than 150 mm fork length. Counts of downstream migrant juvenile wild Chinook and coho salmon were made for three size categories. They were 1) fish less than 50 mm fork length, 2) fish 50-69 mm fork length, and 3) fish greater than 69 mm fork length. A random sample of downstream migrant wild and hatchery salmonids were measured to the nearest millimeter fork length and weighed to the nearest 0.1 gram. Scale samples were collected from a random sample of wild downstream migrant salmonids greater than approximately 69 mm fork length. Scale samples were mounted on glass slides and sent to the ODFW's research laboratory in Corvallis, Oregon. Experienced ODFW staff analyzed the scale samples and determined freshwater age using methods described by Borgerson (1992). Data was recorded on a computerized data entry form and keypunched into a computer database.

Downstream migrant salmonids were sampled at the mainstem migrant trap to estimate numbers of out-migrant rb-st and to monitor the temporal distribution of both the pre-smolt and smolt salmonid migration from the Hood River subbasin. Estimates of migration timing were based on bi-weekly counts at the migrant trap. Bi-weekly counts were not adjusted for seasonal variation in trap efficiency because recapture rates were typically to low to accurately estimate trap efficiency for all unique time periods that smolts were migrating through the Hood River subbasin.

Rainbow-steelhead were used to indirectly estimate steelhead smolt migration timing because no accurate methodology exists to visually identify rainbow trout from downstream migrant steelhead smolts. To estimate migration timing for steelhead smolts, it was also necessary to define a cutoff date in which the majority of smolts should have migrated past the trapping facilities. Based on the distribution of bi-weekly catches of migrant rb-st, the ending date for the steelhead smolt migration was fixed at 31 July.

No accurate methodology exists to visually identify downstream migrant rb-st as either steelhead smolts, steelhead pre-smolt migrants, or resident rainbow trout. Consequently, it is difficult at this time to develop a statistical estimate of smolt production for the Hood River subbasin. Subbasin smolt production was estimated by applying a pre-defined size break to the statistical estimate of out-migrant rb-st. Migrants less than or equal to 165 mm fork length were assumed to be out-migrant rainbow trout or pre-smolt steelhead and migrants greater than 165 mm fork length were assumed to be out-migrant steelhead smolts. The size break was developed based on information available from adult scale analysis (*see* Olsen 2008) and age specific length frequency of downstream migrant rb-st (*see* Olsen 2008). No freshwater age-0 migrant rb-st were classified as steelhead smolts based on the fact that a sub-yearling smolt life history pattern has never been detected on scale samples collected from adult steelhead escaping to the Hood River subbasin.

The 165 mm size break was established based on four primary assumptions: 1) that most freshwater age-3 migrants are steelhead smolts; 2) that physiological changes associated with the smolting process are, in part, initiated by size; 3) that the size range of freshwater age-3 migrant rb-st in the sample population is an indicator of the size range of downstream migrant steelhead smolts; and 4) a small percentage of freshwater age-3 migrants probably rear for an additional year in the lower 4.5 miles of the Hood River subbasin, or in the mainstem of the Columbia River, prior to migrating as freshwater age-4 smolts. The 165 mm fork length size break was defined based on the minimum size of age-3 rb-st collected at the mainstem migrant trap in 1994. The smallest age-3 rb-st migrant, collected at the mainstem migrant trap in 1994 prior to 1 August, was 168 mm fork length. The size range observed in 1994 was used to develop the hypothetical size break at which smoltification occurs, rather than the size ranges observed in subsequent years, because it provided the basis for adjusting the age-3 category to account for the small percentage of this age category which may migrate past the mainstem migrant trap as pre-smolts. This adjustment is made based on the fact that a small percentage of wild adult steelhead have a freshwater age-4 life history pattern (*see* Olsen 2008). All age-4 migrants are assumed to be steelhead smolts.

The percentage of migrants less than or equal to 165 mm fork length averaged 32% and ranged from 0-50% for freshwater age-1 migrants, averaged 23% and ranged from 15-40% for freshwater age-2 migrants, and averaged 11% and ranged from 0-19% for freshwater age-3 migrants; for migrants collected at the mainstem migrant trap during the 1994-2007 sampling seasons (unpublished data on 3/31/2008 from ODFW, Fish Research, High Desert Region, Mid-Columbia District, The Dalles, Oregon). Numbers of steelhead migrating as freshwater age-1, age-2, and age-3 smolts were estimated by adjusting the number of out-migrant rb-st by the percentage of migrants estimated to be in the larger size range for the corresponding age category.

Mark-recapture methodologies were used to estimate numbers of wild, natural, and hatchery produced anadromous salmonid smolts migrating past each downstream migrant trap. Estimates of smolt production for wild and naturally produced salmonids were based entirely on downstream migrants classified in the largest size category associated with each species. We established this criteria based on the assumption that virtually all downstream migrant salmon and steelhead smolts would be in the largest size category. A pooled Petersen estimate with Chapman's modification (Ricker 1975) was used to estimate numbers of downstream migrants, by species and size category, as follows:

$$\hat{N} = \frac{(M+1)(C+1)}{(R+1)}$$

where

$\hat{N}$ = estimated number of downstream migrants passing the rotary-screw trap,
M = number of migrants marked and released above the rotary-screw trap,
C = total number of unmarked and marked migrants captured at the rotary-screw trap, and
R = number of marked migrants recaptured at the rotary-screw trap.

Approximate 95% confidence intervals (C.I.) were calculated as follows (Seber 1973, cited by Lindsay et al. 1986; Ott 1977, cited by Lindsay et al. 1986):

$$95\%\ C.I. = \hat{N} \pm 2\sqrt{\hat{V}(\hat{N})}$$

and

$$\hat{V}(\hat{N}) = \left(\frac{M^2 B^2}{R^4}\right) R \left(1 - \frac{R}{M}\right) + \left(\frac{M^2}{R^2}\right) B \left(1 - \frac{B}{\hat{N} - M}\right)$$

where

$\hat{V}(\hat{N})$ = variance of estimated migrant abundance and
B = number of unmarked migrants in the capture sample (C-R).

In 1994, downstream migrant salmonids were uniquely marked with a top caudal fin clip at the mainstem migrant trap, and with a bottom caudal fin clip at migrant traps located in the East and West forks of the Hood River. Downstream migrant salmonids were uniquely marked with a panjet needle-less injector from 1995 through 2005. The panjet was used to shoot a narrow high speed stream of colored dye at selected fins. This process permanently marked the fin with a unique color by infusing a small amount of the colored dye below the epidermal layer. The dye color was changed every two weeks to uniquely mark fish for defined time intervals during the sampling period. Additionally, a small piece of either the top or bottom lobe of the caudal fin was removed from fish sampled at the mainstem migrant trap. This unique mark was applied to fish sampled at the mainstem migrant trap to 1) facilitate the identification of fish marked at the mainstem trap from those marked at all the other traps, and 2) provide an additional means for identifying fish marked at the mainstem migrant trap in cases where a poorly applied color mark was not readily visible. Unique dye color and marked fin combinations were also assigned to each trap so that the origin of recaptures at the mainstem migrant trap could be determined.

In late fall of 2004, we began inserting Passive Integrated Transponder (PIT) tags into virtually all wild salmonids captured at each of the downstream migrant traps. The general exception was for those migrants less than approximately 80 mm fork length. Smaller migrants were generally counted and released both unmarked and untagged below the migrant traps. Downstream migrant hatchery summer and winter steelhead were either pan-jetted or PIT tagged in the fall of 2004 (i.e., predominately pan-jetted). Beginning with the 2005 sampling season, we PIT tagged virtually all downstream migrant wild salmonids captured at the various migrant traps located in the Hood River subbasin. The PIT tag was then used as the unique mark for identifying location and time of marking. We continued to use a pan-jet in 2005 to uniquely mark hatchery summer and winter steelhead at each of the migrant traps; in addition to applying either a top or bottom caudal fin clip to hatchery summer and winter steelhead caught at the mainstem migrant trap. As in the fall of 2004, wild downstream migrant steelhead caught in 2005 were not PIT tagged if they measured less than approximately 80 mm fork length. In 2006, we discontinued using both the pan-jet and caudal fin clips as identifying marks, and began exclusively marking downstream migrants with a PIT tag in order to implement our mark and recapture program. Virtually all downstream migrant wild salmonids above 80 mm fork length were PIT tagged in 2006 and we began PIT tagging the greater percentage of all non- PIT tagged hatchery summer and winter steelhead that were captured at each of the migrant traps. A random sample of hatchery summer and winter steelhead that were previously PIT tagged at Oak Springs Hatchery, and subsequently caught for the first time at a given migrant trap, were transported and released upriver of the migrant trap as part of the mark release group. The PIT tag was then used to identify the hatchery smolt as a recapture when it was again caught at the migrant trap.

Season totals of M, C, and R were used to estimate the number of downstream migrants passing each trap; with the exception of estimates of wild rb-st and hatchery steelhead migrants passing the mainstem migrant trap in 1995, and wild rb-st migrants passing the mainstem migrant trap in 2001. Sampling periods in both 1995 and 2001 were broken up into irregularly defined time periods and the corresponding values of M, C, and R were used to estimate the number of downstream migrant wild rb-st passing the migrant trap for each of the time periods. Estimates for each time period were then summed to estimate the season total. We used this methodology in 1995 and 2001 because trapping efficiencies were low in both years, and the revised methodology appeared to more accurately estimate numbers of downstream migrants at the lower trapping efficiencies. This hypothesis is supported by the relationship between the wild and hatchery smolt-to-adult survival rates and between summer low flow and subbasin smolt production (*see* Olsen 2008). Race specific estimates of hatchery summer and winter steelhead smolts passing the mainstem migrant trap in 1995 were based on the mark and recapture rates associated with downstream migrant wild rb-st.

The revised methodology was also used to estimate the number of downstream migrant rb-st passing the mainstem migrant trap in 1994, 1996-1997, 1999-2000, and 2002-2007. Estimates derived from the revised methodology were compared with estimates derived from the standard methodology to determine if the two methodologies produced significantly different results. Estimated numbers of downstream migrant rb-st, derived from the revised methodology, ranged from -31.94% to +9.4% of the estimates derived from the standard methodology (unpublished data on 3/31/2008 from ODFW, Fish Research, High Desert Region, Mid-Columbia District, The Dalles, Oregon). The higher recapture rates obtained in 1994, 1996-1997, 1999-2000, and 2002-2006 (Appendix Table A-1) are believed to be the primary factor contributing to the minimal difference in the estimates derived from each methodology. The only exception occurred in 1998 when the recapture rate (i.e., trapping efficiency) for the sampling season was 4.4% (Appendix Table A-1). The revised methodology increased the 1998 estimate of wild downstream migrant rb-st passing the mainstem migrant trap by 12% and the 2007 estimate by 32%. We do not believe, however, that the alternative methodology accurately estimated downstream migrant rb-st in either 1998 or 2007. The rationale for this hypothesis was based on the fact that in 1998 a number of marked fish were recovered 2-5 weeks after having been marked, and in 2007 the recapture rate was low and recaptures were not uniformly distributed throughout the sampling period. This made it difficult to divide the sampling season into defined time periods when uniquely marked juveniles, and the corresponding recaptures, could both be assigned to the same time period. This problem generally appeared to create a situation whereby the revised methodology was inflating the estimate of downstream migrants.

Race specific estimates of steelhead smolt production, by year of migration as smolts, were determined using the following formula:

$$S_r = \sum_{j=1}^{FW} \left[R_j \Big/ \left(\frac{\sum_{i=1}^{SW} A_{ij}}{P_j} \right) \right]$$

where

r = race of steelhead (i.e., summer or winter steelhead),
FW = total number of juvenile freshwater age categories,

SW = total number of adult saltwater age categories,
R_j = race specific adult returns for the j^{th} freshwater age category,
A_{ij} = total adult steelhead returns for the i^{th} saltwater age category and the j^{th} freshwater age category,
P_j = subbasin steelhead smolt production estimated for the j^{th} freshwater age category, and
S_r = smolt production for race of steelhead (r).

Adult Trapping: An upstream migrant adult fish collection facility (Powerdale Dam trap) was installed at Powerdale Dam in December 1991. Powerdale Dam, which is owned and operated by PacifiCorp, is located at RM 4.5 in the mainstem Hood River (Figure 1). The Powerdale Dam trap was installed in the uppermost pool of an existing fish ladder located on the east bank of the mainstem Hood River. The stop-log water intake control of the fish ladder was modified to allow water to flow through a submerged orifice into the ladder. A removable bar grate with one inch spaces between bars blocked the submerged orifice to prevent fish from exiting the top pool of the ladder. A fyke, installed at the entrance to the uppermost pool, prevented fish from backing down the ladder after they entered the uppermost pool. A wood slat cover was put on the trap to prevent fish from jumping out of the trap, and a lock on the cover prevented poaching. A false floor of wood slats was installed at the bottom of the trap to reduce the depth of the trap from about 4.5 feet to about 2 feet. This modification facilitated removal of the fish. In June 1992, the submerged fyke was replaced with a finger weir because it was observed that spring Chinook salmon would avoid swimming through the submerged fyke and would often try to jump over it. There was no delay in migration timing, or other abnormal fish behavior, observed with the new design.

Beginning in late 1995, and continuing through early 1997, a new trapping facility was constructed at Powerdale Dam. The new trapping facility utilized the existing fish ladder on the east bank of Powerdale Dam to divert upstream migrant jack and adult salmonids into a temporary holding area where they could be crowded into a fish lock and elevated into the working area of the trapping facility. In the working area of the trapping facility, fish are transitioned from the fish lock to a staging tank; from the staging tank to an anesthetic tank; and from the anesthetic tank to the sampling area. A network of tubes, located in the sampling area, are used to transfer fish from the working area to either 1) the adult holding pens (primarily used for holding hatchery broodstock); 2) the mainstem Hood River above Powerdale Dam; or 3) a portable fish liberation tank for transport and release in either the mainstem of the Hood River (RM 0.1), Kingsley Reservoir (beginning 19 June, 2000), Taylor Lake (beginning 10 January, 2000), Lost Lake (beginning 22 July, 2004), or Bikini pond (beginning 18 May, 2005). Kingsley Reservoir (i.e., Green Point upper reservoir) is located at the head of Ditch Creek; which is a tributary to the mainstem of the Hood River. Taylor Lake drains into the mainstem Columbia River (RM 186.1) near the city of The Dalles, Oregon. Lost Lake is located at the headwaters of Lake Branch; which is a tributary to the West Fork of the Hood River. Bikini pond is a self contained pond located off the Columbia River (RM 181) near the city of Rowena, Oregon. Prior to transfer, all jack and adult salmonids are tagged with a uniquely numbered floy tag which is inserted below the base of the dorsal fin. Mini-jack spring Chinook salmon are either 1) tagged with an unmarked colored floy tag and passed above Powerdale Dam or 2) killed for the coded wire tag.

The disposition of jack and adult salmonids, that are released back into the Hood River subbasin, are determined for each species and race of salmonid based on both the stock of origin and the salmonids fin and maxillary mark combination. Unmarked adult steelhead are passed above Powerdale Dam except when they are 1) collected for hatchery broodstock or 2) have a highly deformed dorsal fin. Adult steelhead with a highly deformed dorsal fin are assumed to be an unmarked hatchery adult and are transported for release at RM 0.1 in the mainstem of the Hood River. Wild steelhead collected for hatchery broodstock are released back into the mainstem of the Hood River after they are spawned, or when they are no longer needed for hatchery broodstock. Males collected for hatchery broodstock are transferred to the Powerdale Dam trap where they are passed above Powerdale Dam. Females collected for hatchery broodstock are transferred to the Powerdale Dam trap where they are passed above Powerdale Dam if 1) they are not used for hatchery broodstock, 2) retain more than 10-20% of their eggs subsequent to spawning, or 3) are only partially spawned. Females are released at RM 0.1 in the mainstem of the Hood River if they retain less than 10-20% of their eggs subsequent to spawning.

Unmarked steelhead collected for hatchery broodstock, and subsequently classified as a hatchery fish based on scale analysis, are either killed or released at RM 0.1 in the mainstem of the Hood River. Non-indigenous stocks of hatchery adult steelhead (i.e., strays) are transported for release at RM 0.1 in the mainstem of the Hood River. Hatchery steelhead were classified as strays based on fin and maxillary mark combinations. Hood River stock hatchery adult winter steelhead are passed above Powerdale Dam in numbers not to exceed a 50:50 ratio between the wild and Hood River stock hatchery components of the winter run.

The Hood River stock hatchery summer steelhead program was first implemented beginning with the collection of hatchery broodstock from the 1997-1998 run year (1998 brood). Progeny of the 1998 brood first returned to the Powerdale Dam trap as 1-salt adults in the 2000-2001 run year. Hatchery guidelines regulated the number of Hood River stock hatchery adult summer steelhead that could be passed above Powerdale Dam prior to the 2003-2004 run year. Guidelines were designed to 1) remove 1998 brood hatchery adults from the hatchery component of the run passed above Powerdale Dam and 2) regulate the number of 1999-2000 brood hatchery adults that could be passed above Powerdale Dam in the 2001-2002 through 2002-2003 run years. Progeny of the 1998 brood were not allowed above Powerdale Dam because they were deemed to be genetically unfit. This assumption was based on the fact that the 1998 brood was comprised of only two males and nine females (*see* Olsen 2008) and hatchery spawning did not comply with the HRPP's existing hatchery protocols and guidelines; which were designed to maintain maximum genetic diversity in the hatchery production group.

The number of hatchery summer steelhead passed above Powerdale Dam in the 2001-2002 run year was restricted in order to prevent the HRPP from swamping the 2002 brood wild population with a hatchery run comprised of a single saltwater age category (i.e., 1999 brood 1-salt hatchery adults). The number of hatchery summer steelhead passed above Powerdale Dam in the 2002-2003 run year was regulated to randomly pass 1-salt (2000 brood) and 2-salt (1999 brood) hatchery adults above Powerdale Dam in numbers not to exceed a 50:50 ratio between the wild and Hood River stock hatchery components of the summer run. Hood River stock hatchery summer steelhead were randomly passed above Powerdale Dam from throughout the entire hatchery component of the run, beginning with the 2003-2004 run year.

Adult summer steelhead were passed above Powerdale Dam in numbers designed to maintain a 50:50 ratio between wild and subbasin hatchery components of the run. This guideline remained in effect through 2005, while the HRPP's co-managers considered options for significantly increasing the ratio of Hood River stock hatchery summer steelhead adults passed above Powerdale Dam (see Olsen 2003). Various options were considered that provided a mechanism designed to more rapidly (and fully) seed existing habitat; which at the time was assumed to be under seeded. The HRPP's co-managers ultimately developed and approved a strategy which came to be called the "boost" strategy. However, no action was taken on the proposal, primarily because escapements of wild summer steelhead gradually increased through the 2002-2003 run year; minimizing the need for implementing the boost strategy. It is unknown at this time when, or even if, the proposed boost strategy will be implemented in the Hood River subbasin, but the continued decline of the wild run of summer steelhead through the 2007-2008 run year is cause for some concern.

It is unlikely that the boost strategy, as originally proposed, will be implemented in the Hood River subbasin, but the continued decline in the wild run of summer steelhead would suggest that a more biologically conservative variant of this strategy may need to be considered when developing options for achieving the Hood River subbasins numerical fish objectives for wild summer steelhead. Options would be developed in the context of the large body of quantitative data collected on subbasin spawner capacity (Underwood et al. 2003), overall genetic fitness of the Hood River stock of hatchery summer steelhead (Araki and Blouin 2005; Blouin and Araki 2004; Blouin and Araki 2005; Blouin and Araki 2006; Araki et al. 2007a, Araki et al. 2007b, and Araki et al. 2007c), subbasin smolt production capacity (Underwood et al. 2003; Olsen 2008); in-basin egg-to-smolt and smolt-to-adult survival rates (Olsen 2008); and adult escapements (Olsen 2008).

All unmarked and marked spring Chinook salmon are passed above Powerdale Dam; with the exception of those jack and adult fish collected for hatchery broodstock. Unmarked and marked (stray) fall Chinook and coho salmon were passed above Powerdale Dam through the 2000 run year. The HRPP discontinued passing marked (i.e., stray) fall Chinook and coho salmon above Powerdale Dam beginning with the 2001 run year. This protocol remained in effect through the 2007 run year.

Virtually all hatchery jack and adult salmonids are transported downriver for release at RM 0.1 in the mainstem of the Hood River if they are not 1) passed above Powerdale Dam, 2) collected for broodstock, 3) sacrificed for a coded wire tag, or 4) transferred to pre-determined off-station release sites. Hatchery salmonids are released at the mouth of the Hood River based on the assumption that they will return to the Powerdale Dam trap, and in so doing will again be subject to sport and tribal fisheries located below Powerdale Dam. Adult salmonids that were caught at Powerdale Dam, hauled back to the mouth of the Hood River, and then released at RM 0.1 in the mainstem of the Hood River were classified as "recycled" adults. Virtually all tagged salmonids were again recycled through the fishery as they returned to the Powerdale Dam trap. This policy was implemented through early 2005.

In 2005, the HRPP began fully implementing a program where trap operators would caudal punch selected adult hatchery steelhead returning towards the middle or tail end of a given run year. The caudal punch was intended to provide the trap operators the ability to quickly identify how many times the adult steelhead had returned to the adult collection facility. Hatchery adult steelhead that returned to the Powerdale Dam trap with three or more caudal punches would then be candidates for transportation and release into either Taylor Lake, Kingsley Reservoir, Lost Lake, or Bikini pond; depending on time of year, road conditions, and water temperatures at the off station release sites. This protocol remained in effect through the 2007 run year.

The Powerdale Dam trap was checked on a daily basis from December 1991 through January 1997, except during the winter when low stream temperatures typically slow the upstream migration of jack and adult salmonids. The new trapping facility at Powerdale Dam, which came on line in February 1997, was checked every one to three days depending on the number of jack and adult salmonids escaping to the facility. The flexibility to sample the new trapping facility at a lower rate was made possible by the facilities increased adult holding capacity. Generally, the trap was checked in the morning in order to minimize the potential handling stress that is associated with sampling fish during the afternoon, when water temperatures are typically higher. Prior to handling, all fish were tranquilized in a holding tank charged with CO_2.

Jack and adult salmonids were identified by species, classified by sex, and examined for injuries. Prior to 2006, injuries were categorized as either a predator scar, net mark, hook scar, or a scrape. In 2006, trap operators began reporting more specifically those injuries which appeared to be caused by seals. The general category of predator scars included both closed and open wounds. A closed wound is typically an "M" shaped marine mammal scar where scales are missing and the skin is scratched. An open wound is one in which the skin is broken. Net marks are distinguished by a raw, rubbed mark on the leading edge of the dorsal fin. Generally, marks from the net twine can be seen encircling the fish. Hook scars include both fresh and healed wounds. Fresh hook scars were identified by either torn or abraded skin in the area of the mouth. Healed hook scars were typically identified by a missing maxillary or deformed jaw. A wound was classified as a scrape if the wound did not appear to be the result of a predator and the skin was either 1) scratched or abraded or 2) the scales were missing.

Summer and winter races of steelhead were distinguished based on fin and maxillary mark combinations, external coloration, degree of scale tightness and scale erosion, state of sexual maturity relative to the time of year, external parasite load, color of gill filaments, and general appearance. Spring and fall races of Chinook salmon were distinguished based on run timing, external coloration, and general appearance. Subsequent to the physical examination, virtually all jack and adult salmonids were measured to the nearest 0.5 cm fork length. A random sample of summer and winter steelhead and spring Chinook salmon collected for hatchery broodstock were weighed to the nearest 0.1 kg. All field data was entered on a computer form and keypunched into a database.

Fecundity was estimated for wild and hatchery summer and winter steelhead adults used as hatchery broodstock. Females used for hatchery broodstock were air spawned and the number of eggs per female was estimated with a volumetric displacement technique. The fecundity estimate for a given female was not incorporated into the sample population if it appeared that the female retained more than 5-10% of her eggs. Estimates were not adjusted to account for potential egg retention.

Scale samples were collected from virtually all jack and adult salmonids sampled at the Powerdale Dam trap. Samples were collected from the key scale area, which is located above the lateral line behind the posterior end of the dorsal fin. Scales were collected from one, or both, sides of the fish and placed into uniquely numbered scale envelopes. Scale samples were later mounted on gummed cards and sent to ODFW's research laboratory in Corvallis, Oregon; where acetate impressions were made of the scale samples. Experienced ODFW staff viewed the scale impressions under a microfiche to determine both the origin (wild or hatchery) and freshwater/ocean age category of each jack and adult salmonid in the scale sample. Scales were analyzed using methods described in Borgerson (1992).

Summer and winter races of adult steelhead were classified as either a wild, subbasin hatchery, or stray hatchery adult based on 1) the fin and maxillary clip combination (mark combination) and 2) scale analysis. Scale analysis was used to determine if an unmarked adult was either a wild or hatchery produced fish. Unmarked wild adult summer and winter steelhead were assumed to be the progeny of wild production in the Hood River subbasin. Unmarked hatchery adult summer and winter steelhead were assumed to be the mis-marked progeny of subbasin hatchery production releases in the Hood River subbasin. The number of unmarked hatchery adult summer and winter steelhead sampled in the Hood River subbasin is typically low. This is based on the fact that 100% of both hatchery summer and winter steelhead production groups are marked prior to release. The only exception being that Big Creek stock production groups were released unmarked, prior to the 1989 brood release (*see* Olsen 2008). Progeny of unmarked Big Creek stock brood releases returned in the 1990-1991 and 1991-1992 run years.

Marked adult summer and winter steelhead were classified as progeny of Hood River stock production releases if the identifying mark combination was valid for the corresponding brood year of release (*see* Olsen 2008). Marked adult summer and winter steelhead were classified as stray fish if the mark combination was valid for a Hood River stock production release, but invalid for the corresponding brood year of release. In both cases, the brood year of release was determined from scale analysis. Marked adult summer and winter steelhead were assumed to be progeny of a Hood River stock production release if the age of the adult could not be determined, but the identifying mark combination was valid for a Hood River production release. This occurred in the very rare circumstance when either 1) no scales were collected from an adult or 2) all the scales collected from an adult were regenerated. Adult summer steelhead marked with a single adipose clip were assumed to be the progeny of Skamania stock production releases in the Hood River subbasin. Marked adult summer and winter steelhead were classified as stray adults if they bore a mark combination that did not correspond to a combination released in the Hood River subbasin; with two exceptions. Hatchery adult summer steelhead with a single maxillary clip, or a single maxillary clip in combination with an adipose clip, were typically (but not always) assumed to be a Hood River stock hatchery summer steelhead adult, even if the mark combination was invalid for the brood release; as determined from the scale read. This exception was applied to hatchery adults that aged back to the 1998-2006 broods because of 1) the high mis-mark rate observed on juveniles sampled at OSH, 2) the potential for mis-coding of marked adults at the Powerdale Dam collection facility, and 3) the fact that very few identifiable hatchery summer steelhead strays (i.e., based on coded wire tagged adults or known invalid marks) are observed at the Powerdale Dam collection facility. A similar exception was used for winter steelhead. Hatchery winter steelhead with an adipose or single ventral fin clip combination were typically (but not always) assumed to be a Hood River stock hatchery winter steelhead adult, even if the mark combination was invalid for the brood release; as determined from the scale read. Again, this exception was applied to hatchery adults that aged back to the 1992-2006 broods because of 1) the high mis-mark rate observed on juveniles sampled at OSH, 2) the potential for mis-coding of marked adults at the Powerdale Dam collection facility, and 3) the fact that very few identifiable hatchery winter steelhead strays (i.e., based on coded wire tagged adults or known invalid marks) are observed at the Powerdale Dam collection facility.

Scale analysis identified a number of unmarked steelhead as hatchery fish and marked steelhead as wild fish (i.e., origin unknown). The latter group includes marked wild and natural strays and Hood River stock wild steelhead which either had deformed fins or had the fins removed by sport anglers. Fin removal, by anglers, has been observed in the Hood River subbasin (personal communication on 11/17/1993 with Jim Newton, ODFW, Mid-Columbia District, The Dalles, Oregon; unpublished data on 04/07/2008 from ODFW, Fish Research, High Desert Region, Mid-Columbia District, The Dalles, Oregon). The former group includes steelhead that were either mis-classified as hatchery fish or were unmarked hatchery fish. Unmarked hatchery steelhead are believed to primarily be progeny of subbasin hatchery production releases because of problems associated with poor marking of both hatchery summer and winter steelhead smolts. Numbers of adult steelhead in either of the two above groups was typically low.

Migration timing, sex ratio, and age structure was estimated from only those adult steelhead in which scale analysis classified the origin of an unmarked adult as wild and a marked adult as hatchery. Freshwater/ocean age category and mark combination was then used to classify a marked adult steelhead as either a subbasin or stray hatchery produced steelhead. The above protocol was designed to minimize the potential for biasing stock and race specific estimates for populations of wild and hatchery adult steelhead in the Hood River subbasin.

Unmarked "hatchery" adults and marked "wild" adults were summarized as subbasin hatchery or wild adults, respectively, for purposes of estimating escapement. Unmarked and marked (i.e., with a subbasin mark combination) steelhead of unknown origin were allocated to wild and subbasin hatchery components of the run based on the marked wild:unmarked hatchery ratios in the corresponding scale verified population. Unaged steelhead were allocated into specific age categories using the age structure estimated for the corresponding component of the run to which they were assigned; with one exception. Marked steelhead with a regenerated scale pattern were assumed to be a subbasin hatchery produced adult with a freshwater age-1 life history pattern if 1) the mark combination was valid for a hatchery production release in the Hood River subbasin, 2) the salt water life history pattern could be determined from the scale sample, and 3) the mark combination was valid for the estimated brood year of release.

Jack and adult spring Chinook salmon were classified as either a natural, subbasin hatchery, or stray hatchery produced fish based on 1) the mark combination and 2) scale analysis. Scale analysis was used to determine if an unmarked spring Chinook salmon was either a natural or hatchery produced fish. Unmarked naturally produced spring Chinook salmon were assumed to be the progeny of natural production in the Hood River subbasin.

Unmarked hatchery spring Chinook salmon were assumed to be the mis-marked progeny of subbasin hatchery production releases in the Hood River subbasin. The number of unmarked hatchery spring Chinook salmon sampled in the Hood River subbasin is typically low because 100% of the hatchery production group is marked prior to release. The only exception being that subbasin production groups were released either entirely, or partially, unmarked prior to the 1994 brood release (*see* Olsen 2008). Progeny of unmarked Carson and Deschutes stock brood releases returned in the 1992-1998 run years.

Marked jack and adult spring Chinook salmon were classified as progeny of a Carson or Deschutes stock production release if the identifying mark combination was valid for the corresponding brood year of release (*see* Olsen 2008). Marked jack and adult spring Chinook salmon were classified as stray fish if the mark combination was valid for a Carson or Deschutes stock production release, but invalid for the corresponding brood year of release. In both cases, the brood year of release was determined from scale analysis. Marked jack and adult spring Chinook salmon were assumed to be the progeny of a Carson or Deschutes stock production release if the age of the adult could not be determined, but the identifying mark combination was valid for one of these two stocks of release. This occurred in the very rare circumstance when 1) no scales were collected from an adult or 2) all the scales in the scale sample were regenerated. Marked jack and adult spring Chinook salmon were classified as a stray fish if they bore a mark combination that did not correspond to a combination released in the Hood River subbasin. Migration timing, sex ratio, age structure, and escapements were estimated using the same methods described for summer and winter steelhead.

Jack and adult coho (Oncorhynchus kisutch) salmon were classified as either a natural or stray hatchery produced fish based on 1) the mark combination and 2) scale analysis. Scale analysis was used to determine if an unmarked coho salmon was either a natural or stray hatchery produced fish. Scale samples were not used to determine if unmarked fall Chinook salmon were of hatchery origin because the freshwater life history pattern on the scale is to small to accurately make this determination. Unmarked fall Chinook salmon, and unmarked coho salmon not scale verified as hatchery origin fish, were assumed to be the progeny of natural production in the Hood River subbasin. Unmarked coho salmon, that were scale verified as hatchery origin fish, were classified as stray hatchery fish. Migration timing, sex ratio, age structure, and escapements were estimated using the same methods described for summer and winter steelhead.

Harvest Estimates: Creel surveys year-around to estimate the non-tribal harvest of summer and winter steelhead, spring and fall Chinook salmon, and coho salmon. The survey area extends from the mouth of the Hood River to Powerdale Dam; a distance of approximately 4.5 miles. Currently, there is no creel conducted above Powerdale Dam due to the fact that non-tribal harvest of salmon and steelhead is prohibited above Powerdale Dam. The non-tribal fishery above Powerdale Dam was closed to the harvest of salmon and steelhead on 1 April 1998, and the closure remained in effect through the 2007 calendar year. Three sites are predominately utilized by anglers to gain access to the Hood River below Powerdale Dam.

Two levels of stratification (day type and two week period) were used in summarizing the data. Estimates of catch, catch rate, and effort were determined for both strata. Sampling days were categorized as either a weekend-holiday or week day and total catch was summarized by two week periods (bi-weekly) that encompassed the first through the fifteenth and the sixteenth through the end of each month.

Effort (i.e., total hours fished) for each sample day (H_i) was estimated by developing a pressure curve, from periodic pressure counts, and calculating the area under the curve as follows:

$$H_i = (1/2)\sum_{k=1}^{r}\left[(T_k - T_{k-1})(C_k + C_{k-1})\right]$$

where

r = number of pressure counts per day,
C_k = angler count at the k^{th} pressure count, and
T_k = time at the k^{th} pressure count.

The first and last pressure counts were considered as zero points and were assumed to be one half hour before sunrise and one half hour after sunset. Pressure counts were conducted three to four times during the day. Times were determined by dividing the sampling day into either three or four equal length periods and conducting a pressure count at the point when angler numbers appeared to be the highest during the period. The direction of surveyor travel for the first pressure count was randomly selected. Subsequent pressure counts were made in the opposite direction of the previous count. Anglers were interviewed throughout the day to obtain catch rate information on both anglers that had completed angling as well as for those that had not completed angling. The catch rate in fish per angler hour on day i (R_i) was estimated by:

$$R_i = \sum_{j=1}^{m_i} f_{ij} \Big/ \sum_{j=1}^{m_i} h_{ij}$$

where

m_i = number of anglers interviewed on the i^{th} day,
f_{ij} = number of fish caught by the j^{th} angler on the i^{th} day, and
h_{ij} = number of hours fished by the j^{th} angler on the i^{th} day.

Total daily catch in numbers of fish on day i (TC_i) was estimated by:

$$TC_i = (R_i)\,(H_i)$$

Total catch for a given stratum (TC_s) was estimated by:

$$TC_s = (N/n)\sum_{i=1}^{n} TC_i$$

where

N = number of days within a stratum and
n = number of days sampled within a stratum.

Variance for the estimate of total catch in a given stratum [$V(TC_s)$] was estimated by:

$$V(TC_s) = N^2(1-(n/N))(S_b^2/n) + (N/n)\sum_{i=1}^{n}\left[(1-(\sum_{j=1}^{m_i} h_{ij}/H_i))(H_i^2)(s_w^2/m_i)\right]$$

where

$$S_b^2 = \sum_{i=1}^{n}(TC_i - \overline{TC})^2/(n-1)$$ (i.e., between day variance),

$$\overline{TC} = \sum_{i=1}^{n} TC_i / n$$ (i.e., mean daily catch in stratum, and

$$S_w^2 = \sum_{j=1}^{m_i}(f_{ij}/h_{ij} - R_i)^2/(m_i - 1)$$ (i.e., within day variance).

Total catch in a given stratum was allocated to defined categories of fish (i.e., wild summer steelhead kept, wild summer steelhead released, subbasin hatchery summer steelhead kept, etc.) based on the proportion that each category of fish was represented in the known catch. The proportion in which a category of fish was represented in the stratum catch (p_s) was estimated as follows:

$$p_s = \sum_{i=1}^{n}\left[\frac{H_i}{\sum_{i=1}^{n} H_i} * p_i\right]$$ (includes only those days in which fish were caught)

where

p_i = the proportion of fish caught on the i^{th} day for a given category of fish.

Daily proportions (p_i) for a given category of fish were estimated as follows:

$$p_i = \sum_{j=1}^{m_i} fc_{ij} / \sum_{j=1}^{m_i} f_{ij}$$

where

fc_{ij} = number of fish caught by the j^{th} angler on the i^{th} day for a given category of fish.

Variance for the estimate of the proportion of fish caught in a given category, and stratum [V(p_s)], was estimated by:

$$V(p_s) = \frac{N - n_p}{N n_p \bar{H}_s^2} * \frac{\sum_{i=1}^{n}(H_i p_i)^2 - 2p_s \sum_{i=1}^{n}(H_i^2 p_i) + p_s^2 \sum_{i=1}^{n}(H_i^2)}{(n_p - 1)}$$

$$+ \frac{1}{N n_p \bar{H}_s^2} * \sum_{i=1}^{n}\left[H_i^2 \frac{(H_i - h_i)}{H_i} * \frac{(p_i)(1 - p_i)}{\sum_{j=1}^{m_i} f_{ij}} \right]$$

where

$\bar{H}_s$ = mean daily effort for the stratum and

n_p = number of days sampled in the stratum when fish were caught (i.e., the basis for estimating p_s).

Variance in the estimate of catch for a given category of fish caught within a given stratum [V(C_s)] was derived by:

$$V(C_s) = V(p_s)*(TC_s)^2 + V(TC_s)*(p_s)^2 - V(p_s)*V(TC_s)$$

Bi-weekly and annual estimates of total catch (TC), and the variance associated with each estimate [V_{TC}], were determined for a given category of fish by summing the corresponding stratum estimates. Approximate 95% confidence intervals (C.I.), for a given category of fish, were calculated as follows:

$$95\% C.I. = TC \pm 2\sqrt{V_{TC}}$$

Number of anglers fishing in each stratum was estimated by dividing total effort in the stratum by the mean estimate of effort for anglers that had completed fishing within the stratum. Bi-weekly and annual estimates of angler numbers were determined by summing the corresponding stratum estimates. Formulas used for estimating harvest and 95% confidence intervals were from Carmichael et al. (1988) and from notes dated 05/28/1997 from Mary Buckman, ODFW, Corvallis, Oregon.

12.6) Dates or time period in which research activity occurs.

Juvenile Trapping

Migrant traps are operated daily from early March through early October.

Adult Trapping

The proposed adult trap and weir adult trap at Powerdale Fish Facility is operated five to seven days a week throughout the year.

Harvest Estimates
The creel is conducted throughout the entire year to estimate harvest in the fishery located below Powerdale Fish Facility.

12.7) Care and maintenance of live fish or eggs, holding duration, transport methods.

Egg Collection and Incubation
Steelhead eggs are collected from 1:1 sex ratio mating. Eggs are water-hardened in an iodine antiseptic solution. Family groups are kept separate until viral samples from parent ovarian fluid and sperm has been analyzed. Water-hardened eggs are transported to Oak Springs Fish Hatchery in a portable cooler. Eggs arriving at Oak Springs Fish Hatchery are rinsed in an iodine antiseptic solution before family groups are placed in individual incubation trays. Family groups of eggs may be pooled with other family groups if the viral samples are negative.

Juvenile Trapping
Migrant traps are sampled daily to minimize holding mortality. Pre-smolt and smolt salmonids are typically held in sampling containers for less than an hour to count and bio-sample. If large numbers of salmonids are caught at a given migrant trap then water in the sampling containers is aerated with a portable aerator while the fish are being counted and bio-sampled. Salmonids that are to be released above the trap are quickly transported in large coolers filled with water. If significant numbers of salmonids are being transported upriver, then the water is aerated with a portable aerator.

Adult Trapping
The Powerdale Fish Facility is operated five to seven days to minimize holding mortality. The facility was designed to facilitate the counting and bio-sampling of jack and adult salmonids and to minimize total handling time. A network of tubes located in the facility are designed to quickly, safely, and with a minimum of stress, transport jack and adult salmonids to one of three locations. They include 1) a recovery pond above Powerdale Dam, 2) holding ponds located at the Powerdale Fish Facility, and 3) liberation trucks.

Harvest Estimates
The creel has no protocols associated with the care and maintenance of ESA listed species.

12.8) Expected type and effects of take and potential for injury or mortality.

Juvenile Trapping
Migrant traps are used to sample downstream migrant pre-smolt and smolt salmonids. The migrant trap located in the mainstem of the Hood River samples approximately 3-8% of the downstream migrant salmonids passing the location of the trap. Trapping efficiencies at other migrant traps range from 10-25% depending on fluctuations in stream flow and numbers passing the trap site. Potential for seriously injuring downstream migrants either as a consequence of trapping or handling of the fish appears to be minimal. This assumption is based on past years operation of the migrant traps. The physical appearance of the downstream migrants sampled from the migrant traps indicate that only a very small percentage of migrants may be injured as a consequence

of trapping and handling prior to release. The percentage of mortalities relative to the total number caught is also fairly low (see Section 12.9)

All migrant traps combined annually catch approximately 2-6 kelts (i.e., spawned out adult steelhead) drifting out of the subbasin. Most of these adults are still alive when the traps are sampled and these fish are immediately returned to the river. It is unknown whether or not the additional stress associated with trapping and handling decrease the kelts' chances for survival to return and spawn in another run year.

Adult Trapping
The extent of potential injuries from the proposed trap and weir is unknown.

Based upon project experience from trapping, handling, and tagging of fish at the Powerdale Fish Facility, few injuries have resulted from the Powerdale operation. Post release mortality or injury is unknown from the Powerdale Facility, but it is believed to be low based upon the high incidence of repeat spawners and lack of observation or report of injuries or mortality.

Harvest Estimates
The creel program has no sampling risks associated with the take of ESA listed species.

12.9) Level of take of listed fish: number or range of fish handled, injured, or killed by sex, age, or size, if not already indicated in Section 2 and the attached "take tables" (Table 6-9).

The number of ESA listed pre-smolt and smolt steelhead sampled at all downstream migrant traps, along with the number of mortalities, is summarized in Table 25. The number and disposition of ESA listed adult winter steelhead sampled at the Powerdale Fish Facility are summarized in Table 26 and Table 27, respectively. The combined handling and trapping mortality at the migrant traps ranged from 0.73-2.48% of the total number of rainbow-steelhead caught at the traps. Run year specific estimates of handling and trapping mortality at the Powerdale Fish Facility ranged from approximately 0-4.5% for adult wild summer steelhead and 0-3.5% for adult wild winter steelhead.

Adult Trapping
The proposed trap and weir will be designed to meet both NOAA Fisheries, and ODFW fish trapping criteria. The level of take is expected to be low, however, if unintentional take occurs immediate actions will be implemented to alleviate or reduce the take.

Table 25. Combined catch of rainbow-steelhead and hatchery summer and winter steelhead at migrant traps located in the Hood River subbasin and total number of all mortalities. Data source: Unpublished data on 4/26/2008 from mid-Columbia District Research, ODFW, The Dalles, Oregon).

	Rainbow-steelhead			Hatchery Winter Steelhead			Hatchery Summer Steelhead		
Year	Number Caught	Mort.[a]	Percent Mort.	Number Caught	Mort.	Percent Mort.	Number Caught	Mort.	Percent Mort.
1994	6,231	54	0.87	2,881	94	3.26	1,821	250	13.7
1995	1,320	35	2.65	2,080	31	1.49	3,157	67	2.12
1996	1,406	35	2.49	3,942	15	0.38	5,348	109	2.04
1997	4,437	54	1.22	7,739	437	5.65	1,977	116	5.87
1998	4,495	119	2.65	3,419	119	3.48	19	1	5.26
1999	2,823	29	1.03	3,285	19	0.58	928	7	0.75
2000	6,184	59	0.95	5,006	39	0.78	3,151	17	0.54
2001	916	21	2.29	1,203	28	2.33	864	51	5.90
2002	1,336	15	1.12	2,989	130	4.35	1,823	14	0.77
2003	6,844	129	1.89	3,091	59	1.91	2,106	26	1.23
2004	5,318	89	1.67	5,688	133	2.34	1,796	118	6.57
2005	2,825	15	0.53	5,007	4	0.08	3,802	6	0.16
2006	2,323	7	0.30	2,699	10	0.37	1,815	13	0.72
2007	589	0	0	1,872	0	0	9	0	0

[a] Numbers include fish killed for genetic analysis and for samples requested by the Environmental Protection Agency.

12.10) Alternative methods to achieve project objectives.

There are currently no alternatives to evaluating performance indicators identified in **Section 1.10 List of program "Performance Indicators," designated by "benefits" and "risks."** However, data collected by the research component of the HRPP will be used to develop models that may allow us to drop certain tasks currently being implemented in the subbasin. Hopefully, models can be developed that will be able to estimate wild steelhead smolt production based on the numbers of fish passed above Powerdale Dam. The downstream migrant traps would still need to be operated to evaluate selected performance indicators but the potential elimination of certain tasks could help to reduce the injury and mortality rates on wild steelhead that are specifically associated with marking and bio-sampling.

12.11) List species similar or related to the threatened species; provide number and causes of mortality related to this research project.

The Hood River subbasin supports listed populations of both bull trout, summer steelhead, coho salmon, fall Chinook salmon, and spring Chinook salmon. Juveniles from each of these species are captured in downstream migrants located throughout the basin. Mortality at the downstream migrant traps is low, and within acceptable limits as described on the NOAA Fisheries 4d take permit #OR2008-4186.

Mortality is unknown at the proposed adult trapping site, but it is believed it will be minimal to other species for the following reasons: **Summer steelhead** – Due to the limited trap operation period, the run timing of summer steelhead has little overlap with the trap operation period. Additionally, summer steelhead are primarily distributed in the West Fork of Hood River and not present in the East or West Fork. **Coho salmon –** Due to the limited trap operation period, the run timing of coho salmon has little overlap with the trap operation period. While some coho may be present in the Hood River during the early portion of the trap period, coho are generally not distributed upstream to the proposed trapping site. **Fall Chinook -** Due to the limited trap operation period, the run timing of Chinook salmon has little overlap with the trap operation period. **Spring Chinook –** While run timing of spring Chinook slightly overlaps with the trap operation period, most spring Chinook natural production occurs in the West Fork of Hood River and few are expected to be encountered in the trap. . **Bull trout –** Run timing and distribution of bull trout indicates that bull trout will be subjected to capture at the trap. Bull trout have been captured at Powerdale since 1991 with few injuries, and no mortalities. The trap weir will be designed to meet NOAA Fisheries and ODFW standards to avoid injuries.

and anadromous cutthroat trout. The bull trout population is located in the upper drainage of the Middle Fork of the Hood River and populations of anadromous and resident forms of cutthroat trout are predominately located in the East and Middle fork drainages of the Hood River subbasin; the mainstem of the Hood River; and in selected tributaries to the mainstem of the Hood River. The Powerdale Fish Facility and the downstream migrant traps catch both bull trout and sea run cutthroat trout (Table 28). Number caught at the Powerdale Fish Facility ranged from 0-3 adult anadromous cutthroat trout and 6-28 adult bull trout. Numbers caught at the downstream migrant traps ranged from 13-43 and smolt anadromous cutthroat trout and 0-29 smolt bull trout. No mortality of either species has occurred at the Powerdale Fish Facility. No bull trout, and only two cutthroat trout, have been killed in the entire six years of sampling at the downstream migrant traps.

Table 26. Disposition of adult summer steelhead returning for the first time to the Powerdale Dam adult trap. Counts of wild and hatchery[a] adult summer steelhead may include mis-classified marked and unmarked winter steelhead, respectively. Origin (i.e., wild or hatchery) was determined based on a combination of scale analysis and mark combination. Data source: Olsen 2008.

	Returns to Powerdale Dam		Broodstock collection[b] By origin		Broodstock collection[b] By sex		Numbers passed above Powerdale Dam		Numbers recycled below Powerdale Dam		Mortalities		Transfers[c]	
Run year	Wild	Hatchery	Wild	Hatchery	Males	Females	Wild	Hatchery	Wild[d]	Hatchery[e]	Wild	Hatchery[f]	Wild	Hatchery
1992-1993	490	1,731	--	--	--	--	489	1,722	0	5	1	4	--	--
1993-1994	245	1,111	--	--	--	--	243	1,105	1	4	1	2	--	--
1994-1995	218	1,628	--	--	--	--	217	1,623	0	1	1	4	--	--
1995-1996	132	551	--	--	--	--	131	519	1	28	0	4	--	--
1996-1997	184	1,362	--	--	--	--	179	1,307	2	50	3	5	--	--
1997-1998	81	600	13 (3)	3 (3)	5 (3)	11 (3)	65	448	2	142	1	7	--	--
1998-1999	132	567	31 (9)	3	13 (2)	21 (7)	98	4	0	549 (14)	3	11	--	--
1999-2000	188	487	33	0	12	21	147	2	7	467 (7)	1	15	--	3
2000-2001	221	1,194	27 (3)	0	11	16 (3)	180	1	6	1,167 (199)	8	20	--	6
2001-2002	494	2,335	61 (14)	5 (4)	33 (8)	33 (10)	414	124	19	2,185 (17)	0	21	--	0
2002-2003	708	2,674	78 (32)	3 (3)	37 (13)	44 (22)	543	500	86	2,148 (5)	1	23	--	0
2003-2004	266	2,005	36 (9)	5 (5)	15 (6)	26 (8)	182	205	46 (1)	1,775 (39)	2	20	--	0
2004-2005	233	2,863	38 (4)	3	12 (1)	29 (3)	152	171	42 (7)	2,666 (679)	1	23	--	0
2005-2006	206	1,316	13 (3)	3 (1)	9 (3)	7 (1)	170	136	22 (5)	1,147 (478)	1	21	--	9
2006-2007	194	1,087	23 (2)	3	17	12 (2)	169	174	1	874 (247)	1	5	--	31
2007-2008[g]	176	816	45	0	22	23	120	128	10	657 (268)	0	3	1	28

a Subbasin hatchery summer steelhead returning in the 1992-1993 through 1999-2000 run years were entirely from Foster stock hatchery production releases. Hood River stock hatchery summer steelhead first returned in the 2000-2001 run year as 1 salt adults.

b Pre-spawning mortalities and euthanized unmarked hatchery adults are included in the totals and listed in parenthesis.

c Protocols established in calendar year 2000 at the Powerdale Dam trap allowed trap operators the option to transfer hatchery adult summer steelhead to either Kingsley Reservoir or Taylor Lake upon first return to Powerdale Dam. Summer steelhead were first transferred to Kingsley Reservoir on 19 June, 2000 and Taylor Lake on 10 January, 2000. Protocols established in calendar year 2006 were designed to provide for the transfer of a random sample of Skamania stock hatchery adult summer steelhead to the Parkdale facility for a kelt study. Adults were first transferred to the Parkdale facility on 6 March, 2006 from the 2005-2006 run year.

d Numbers include both unmarked (i.e., with a deformed dorsal fin) and marked adults that were visually identified as a hatchery adult at Powerdale Dam and later classified as a wild adult based on scale analysis.

e Recycled hatchery adults returning more than three times to Powerdale Dam may be euthanized (i.e., depending on the condition of the fish) or transferred to either Kingsley Reservoir, Taylor Lake, Lost Lake, or Bikini pond. The total number of adults, falling into either of these five categories, are summarized in parenthesis and included in the total number of recycled fish. Summer steelhead were first transferred to Kingsley Reservoir on 19 June, 2000; Taylor Lake on 10 January, 2000; Lost Lake on 22 July, 2004; and Bikini pond on 18 May, 2005. A random sample of recaptured Skamania stock adult summer steelhead were also transferred to the Parkdale facility to implement a kelt study. The first recaptured adult was transferred to the Parkdale facility on 8 August, 2006 from the 2006-2007 run year.

f Numbers include adult summer steelhead sacrificed for coded wire tags.

g Preliminary estimate through 12 February, 2008.

Table 27. Disposition of adult winter steelhead collected at the Powerdale Fish Facility. Counts of wild and hatchery[a] adult winter steelhead may include mis-classified marked and unmarked summer steelhead, respectively. Origin (i.e., wild or hatchery) was determined based on a combination of scale analysis and mark combination. Data source: Olsen 2008.

	Returns to Powerdale Dam		Broodstock collection[b] By origin		Broodstock collection[b] By sex		Numbers passed above Powerdale Dam		Numbers recycled below Powerdale Dam		Mortalities		Transfers[c]	
Run year	Wild	Hatchery	Wild	Hatchery	Males	Females	Wild	Hatchery	Wild[d]	Hatchery[e]	Wild	Hatchery[f]	Wild	Hatchery
1991-1992	697	320	70 (3)	35	50 (1)	55 (2)	618	284	0	0	9	1	--	--
1992-1993	415	236	57 (4)	1	30 (2)	28 (2)	345	10	4	222	9	3	--	--
1993-1994	404	176	78 (3)	1 (1)	34 (1)	45 (3)	300	5	13	167 (1)	13	3	--	--
1994-1995	206	111	42	1	23	20	161	5	2	98 (1)	1	7	--	--
1995-1996	279	280	65 (6)	24 (1)	46 (5)	43 (2)	210	161	1	88 (1)	3	7	--	--
1996-1997	290	639	46 (9)	37 (6)	42 (10)	41 (5)	238	252	3	308 (6)	3	42	--	--
1997-1998	227	393	39 (9)	41 (13)	34 (9)	46 (13)	182	174[g]	4	152 (10)[g]	2	26	--	--
1998-1999	298	324	41 (1)	35	33	43 (1)	255	188	1	82 (3)	1	19	--	--
1999-2000	921	302	47	47 (1)	40	54 (1)	865	224	5	21 (1)	4	10	--	--
2000-2001	1,015	952	130	4	69	65	877	656	5	287	3	5	--	--
2001-2002	1,059	1,192	74 (19)	1	37 (7)	38 (12)	950	683	26	344 (8)	9	164	--	--
2002-2003	745	597	66 (15)	3 (2)	31 (8)	38 (9)	654	412	23	177	2	5	--	--
2003-2004	597	1,039	73 (2)	8 (7)	39 (2)	42 (7)	507	570	17	452 (65)	0	9	--	--
2004-2005	345	558	55 (2)	18 (8)	37 (5)	36 (5)	273	246	14 (1)	288 (23)	3	6	--	--
2005-2006	460	906	109	44 (1)	79	74 (1)	342	299	5	555 (15)	4	8	--	--
2006-2007	479	473	54 (1)	5	26 (1)	30	423	364	2	97 (14)	0	6	--	1

[a] Subbasin hatchery winter steelhead returning in the 1991-1992 run year were entirely from the Big Creek stock of hatchery winter steelhead. Subbasin hatchery winter steelhead returning in the 1992-1993 through 1994-1995 were from either the Big Creek, Mixed, or Hood River stocks of hatchery winter steelhead. Subbasin hatchery winter steelhead returning in the 1995-1996 run year, and in all subsequent run years, were entirely from the Hood River stock of hatchery winter steelhead.

[b] Pre-spawning mortalities are included in the totals and listed in parenthesis.

[c] Protocols established in calendar year 2004 at the Powerdale Dam trap allowed trap operators the option to transfer adult steelhead to either Kingsley Reservoir or Taylor Lake upon first return to Powerdale Dam.

[d] Numbers include both unmarked (i.e., with a deformed dorsal fin) and marked adults that were visually identified as a hatchery adult at Powerdale Dam and later classified as a wild adult based on scale analysis.

[e] Recycled adults returning more than three times to Powerdale Dam may be euthanized (i.e., depending on the condition of the fish) or transferred to either Kingsley Reservoir or Taylor Lake. The total number of adults falling into either of these three categories are summarized in parenthesis and included in the total number of recycled fish. Winter steelhead were first transferred to Kingsley Reservoir on 27 April, 2004 and to Taylor Lake on 18 March, 2004. A limited number of euthanized adults were given to Oregon's Environmental Protection Agency for a pesticide study. Adults used in the pesticide study were collected from 23 March, 1998 through 15 April, 1998.

[f] Numbers include adult winter steelhead sacrificed for coded wire tags.

[g] Number was adjusted for winter steelhead that were recycled and subsequently passed above Powerdale Dam upon return to the adult collection facility.

Table 28. Numbers of bull and cutthroat trout caught in the Hood River subbasin at downstream migrant traps and the Powerdale Fish Facility. Data source: Olsen (2008).

	Bull Trout		Cutthroat Trout	
Year	Migrant Traps	Powerdale Fish Facility	Migrant Traps	Powerdale Fish Facility
1992	--	6	--	5
1993	--	2	--	0
1994	1	11	17	0
1995	0	11	13	0
1996	6	18	25	0
1997	12	6	18	3
1998	25	18	43	0
1999	1	28	30	0
2000	1	27	34	1
2001	1	12	6	11
2002	13	5	18	3
2003	0	4	31	7
2004	0	10	42	3
2005	6	7	41	8
2006	1	4	14	6
2007	0	6	19	2

12.12) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed fish as a result of the proposed research activities.

Juvenile Trapping

Migrant traps are sampled daily to minimize mortality associated with trapping stress. Pre-smolt and smolt salmonids collected for bio-sampling are held in water oxygenated with a portable aerator when large numbers of downstream migrants are caught in the trap. The live box on the mainstem migrant trap was also modified from its original dimensions in order to further minimize stress-related mortality associated with the trapping of downstream migrants. The live box was enlarged by about 80%; a side compartment was added to provide some separation of migrants in the live box and to provide an area of reduced turbulence. The number of downstream migrant wild and hatchery steelhead and resident rainbow trout that are marked and released above the trap, to estimate recapture rates at the migrant traps, is limited to a relatively small percentage of the total number caught. This is done to minimize handling mortality.

Adult Trapping

The trap will be equipped with a live-box of sufficient size to prevent injury and safely hold safely hold fish well above expected returns. The trap will be operated daily, and all fish captured will be being either allowed to move upstream. Personnel will be stationed at the trap to guard against vandalism, and ensure that the trap operates in a safe manner through all flow regimes. The Powerdale Fish Facility is operated five to seven days a week to minimize holding mortality. The trapping facility was designed in a manner that minimizes stress related mortality associated with the handling of fish for counting and bio-sampling. Anadromous salmonids can quickly be sampled and transported to selected locations via a network of tubes located in the sampling area.

The tubes are designed to efficiently and safely move fish to either 1) a recovery pond above Powerdale Dam that has an outlet to the mainstem of the Hood River, 2) holding pens located at the Powerdale Fish Facility, or 3) a liberation truck that can be used either to "recycle" fish through the sport fishery, or to transport broodstock to the HRPP's Parkdale facility.

Harvest Estimates
The creel is conducted throughout the entire year to estimate harvest in the fishery located below Powerdale Dam. There are no risk aversion protocols associated with implementing the creel program.

SECTION 13. ATTACHMENTS AND CITATIONS

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the foregoing information is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973."

Name, Title, and Signature of Applicant:

Certified by_____________________________ Date:_____________

BONNEVILLE POWER ADMINISTRATION

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